

Notice No. 3

Rules and Regulations for the Classification of Naval Ships, January 2014

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

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Volume 1, Part 6, Chapter 4, Sections 1, 2 & 4	1 January 2015
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Volume 1, Part 1, Chapter 2

Classification Regulations

Effective Date 1 January 2015

■ Introduction

(Part only shown)

Definition of Hull Naval Class

Naval Ship Classification may be regarded as the development and worldwide implementation of published Rules and Regulations, which, in conjunction with proper care and conduct on the part of the Owner, will provide for:

1. the structural strength and the watertight integrity of all essential parts of the hull and its appendages; this includes compliance with a suitable damage stability standard accepted by LR Lloyd's Register (hereinafter referred to as 'LR');
2. the safety and reliability of propulsion, steering and other essential auxiliary engineering systems;
3. the operation and functioning of associated systems installed for operational requirements relating to the ship type; and
4. the effectiveness of other defined features and systems which have been built into the ship in order to establish and maintain basic conditions on board whereby appropriate stores, fuels, equipment and personnel can be safely carried whilst the ship is at sea, at anchor, or moored in harbour.

A naval ship is said to be in Class when the Rules and Regulations which pertain to it have been complied with, or compliance, equivalent to the Rules, has been ascertained. LR maintains these provisions by way of periodical visits by its Surveyors to the ship as defined in the Regulations in order to ascertain that the vessel currently complies with those Rules and Regulations. Records of any defects found, or modifications carried out, between visits by LR surveyors, which may affect Classification, are to be maintained. Any defects found are to be reported to LR with the minimum of delay. The records will form the basis of remedial action, where necessary, for maintenance of Class.

Options

The handling of safety matters such as ship's stability, life saving life-saving appliances, pollution prevention arrangements and structural fire protection, fire detection and extinction arrangements is the prerogative of the Owner and his delegated Naval Authority Naval Administration. However, where these matters are delegated to LR they will be undertaken in accordance with agreed procedures and appropriate class notations will be assigned and entered into the vessel's Classification record.

Transfer of Information

To achieve naval class it is imperative to ensure that communication between LR, the Owner, Navy Naval Administration, Prime Contractor, Designer and Builder is effective. In designing, building and maintaining a ship to class, it is essential that liaison between the various parties involved is assured. In particular, formal written contracts are

essential for commercial reasons between the contractors, but an additional responsibility rests with all participants to ensure that naval class leads to a transparency of information during construction and thereafter.

■ Section 1

Conditions for Classification

1.1 Framework of Classification

1.1.3 Compliance with the Rules does not relieve the designer of his their responsibilities for compliance with the specification Owner's and Naval Administration's and the requirements for the overall design features, and in-service performance, certification requirements, and standards to which the ship is to be built of the ship.

1.1.5 In addition to confirming compliance with the Rules, LR will, in conjunction with the Naval Authority Naval Administration, require to be satisfied that the ship is suitable for the geographical or other limits or conditions of the service requested.

1.1.8 Where LR is acting on behalf of the Naval Authority Naval Administration, any relevant requirements of the Naval Authority Naval Administration are to be identified and advised to LR in writing.

1.1.9 It is a requirement of classification that a suitable subdivision and stability standard, specified by the Naval Authority, is adopted and complied with. LR will provide advice on this aspect at the request of the Owner/Naval Authority stability and subdivision arrangements are to comply with and be maintained in compliance with a specified standard(s). The specified standard(s) and on-going certification regime are to be notified to LR by the Naval Administration in writing. Where the Naval Authority Naval Administration, or its designated agency recognised organisation, approves the arrangements for compliance with the required stability and subdivision standards, a copy of the following documentation is to be submitted:

- approval documentation issued by the Naval Authority Naval Administration stating that arrangements have been examined against the required standard and are acceptable.
- accepted arrangements of openings, closing appliances, vents, etc., such that the limits of the watertight integrity may be defined at the design draught. From these limits the pressure heads for watertight structure and watertight/weathertight closing requirements for openings, etc., can be identified.

Alternatively, Lloyd's Register (hereinafter referred to as 'LR') where requested, LR will approve the arrangements against the required agreed standard(s).

1.1.10 It is a requirement of classification that fire safety arrangements are to comply with and be maintained in compliance with a specified standard(s). The specified standard(s) and

ongoing certification regime are to be notified to LR by the ~~Naval Authority Naval Administration~~ in writing. ~~LR will provide advice on this aspect at the request of the Owner/Naval Authority, see also 3.9 for the FIRE notation.~~ Alternatively, where requested, LR will approve the arrangements against the agreed standard(s).

1.1.13 It is a requirement of classification that magazine safety arrangements are to comply with and be maintained in compliance with a specified standard(s). The specified standard(s) and ongoing certification regime are to be notified to LR by the ~~Naval Authority Naval Administration~~ in writing. LR will provide advice on this aspect at the request of the Owner/~~Naval Authority Naval Administration~~.

1.4 Owner's responsibilities

1.4.3 Where the ~~Navy/Owner/Naval Administration~~ identifies standards, conducts audits or issues certificates, and the responsibility has not been delegated to LR, LR is to be advised of the identity of the ~~Naval Authority Naval Administration~~ and is to be furnished with all appropriate standards and to have full access to the ~~Naval Authority Naval Administration~~ at all times.

■ Section 2 Scope of the Rules

2.1 Applicable ship types

(Part only shown)

2.1.1 The Rules are applicable to naval ships designed and constructed for the purpose of carrying and operating naval systems. For the purposes of Classification, naval ships can be grouped into four categories as follows:

(d) NSA ships

This category covers auxiliary naval ships used for the support of civil and naval operations. They may have a variety of roles including the movement of military and other personnel, ammunition, vehicles, stores and fuels and the transfer of such to other naval ships. They do not have a defined offensive role but may have a limited self-defence capability. In general, the ships will comply with LR's Rules for Ships and any relevant requirements in Ch 3,17 and satisfy as far as practicable the requirements of the International Conventions applicable to the ship type. Any deviation from the applicable International Convention requires agreement with ~~the Navy or Naval Authority and where applicable the National Administration~~. A Design and Operating Scenario Statement declared by the ~~Navy Owner~~ stating the role of the ship in terms of the carriage of equipment, personnel, stores and fuels is to be acceptable to LR. The assignment of the **NSA** ship type notation is dependent on the ship being in Machinery Naval Class with the **⚓**LMC, **⚓** LMC, **⚓**LMC, **LMC** or **MCH** notations.

There are special requirements for hovercraft, mine-sweepers, landing ships, which are to be designed in accordance with the appropriate ~~sections~~ Sections of relevant LR's Rules and Regulations.

2.2 Definitions

2.2.6 **Naval Authority Naval Administration.** An authority or authorities nominated by the Owner responsible for providing regulation associated with procurement and support of the ship. The ~~Naval Authority Naval Administration~~ may also be responsible for identifying appropriate standards, auditing and certification. The ~~Naval Authority Naval Administration~~ could be a Government department, Statutory Authority, LR or an independent organisation with appropriate standing. In the absence of a clearly defined Naval Administration, LR will refer to the Owner.

2.2.13 **Stability information.** Documents required for stability certification. ~~The form of information is to be specified by the Naval Authority.~~

2.2.14 **Standard.** A set of appropriate requirements and/or criteria that are to be agreed by the Naval Administration prior to the plan appraisal stage.

~~2.2.14~~ 2.2.15 **Concept of operations Operations.** The ~~concept of operations provides information with regard to~~ Concept of Operations (ConOps) is a statement of an Owner's intentions for the operation of the ship. The ConOps describes the ship's intended service in terms of purpose and function ~~(including crewing); and is to include, but not be limited to, information on the following: crewing, operational speeds, wave heights, displacements, service area, temperatures, motions, flight deck aircraft and boat operations; normal and emergency arrangements; and other information pertinent to the design of the ship and arrangements under reasonably foreseeable, normal and abnormal conditions.~~ The ConOps is to be provided by the Owner. LR may accept alternative documents where these provide the information which would be included within the ConOps, in such cases the relevant sections providing the information required to provide equivalence with the ConOps are to be identified.

2.2.16 **System Operational Concept.** A System Operational Concept is a description of the intended operation of each of the major ship systems, that is those comprised of sub-systems and equipment referenced within the Rules. The System Operational Concept is to demonstrate that the systems' architecture, configuration and criticality meet the requirements of the operational scenarios defined by the ConOps. The System Operational Concept statements are to be agreed between the designer and the Owner. LR may accept alternative documents where these provide the information which would be included within the System Operational Concept. In such cases the relevant sections providing the information required to provide equivalence with the System Operational Concept are to be identified.

2.2.17 **System Design Description.** The System Design Description is a document that describes the design of a system or equipment. The System Design Description details the system's capability and functionality under all normal and reasonably foreseeable abnormal operating and fault conditions. The System Design Description documents are to be agreed between the designer and the Owner. LR may accept alternative documents where these provide the information which would be included within the System

Design Description. In such cases the relevant sections providing the information required to provide equivalence with the System Design Description are to be identified.

2.2.18 Engineering and Safety Justification. A statement or report which provides a reasoned and compelling argument supported by a suitable body of evidence, that either the system or sub-system under consideration will operate as intended for a defined application in a defined environment or in the case of a deviation from the Rules, evidence that the proposed alternative arrangements are equivalent. This is to include details of the safety implications and protective measures to be implemented to mitigate risks associated with the system or alternative arrangements. It may include references to design standards used, assumptions and technical evidence such as analysis or test reports. Where required this is to be derived from a Risk Based Analysis in accordance with Vol 1, Pt 1, Ch 2. It may include:

- (a) Possible failure modes of internal components and measures adopted to mitigate such failures that may have an effect on the internal machinery or the surrounding environment/structures/systems, taking due account of suitability of materials and the effects of stress raisers, etc.
- (b) Operating parameters and any required limitations.
- (c) Details of life-limited critical components, including their declared lives and residual lives or balance of planned life remaining, in terms of operating time or operating cycles, or where life is derived from declared acceptance criteria, and the associated maintenance strategies.
- (d) Installation arrangements.
- (e) Details of potential failures that could lead to hazardous or major consequences and/or degradation in systems performance that could lead to failures and which are to be notified to the Operators.
- (f) Common failure modes and measures to minimise potential single points of failure such as system redundancy and environmental separation of equipment and services.
- (g) Identification of failure modes of the defined integrated system.

In addition, an Engineering and Safety justification is to be provided for each deviation from the Rule requirements, such deviations are normally raised by the designer or Builder and are to be agreed with the Owner and Naval Administration. In some cases a full justification and Risk Assessment may be required. See *Requirements for Machinery and Engineering Systems of Unconventional Design*, Vol 2, Pt 1, Ch 2 and *Risk Assessment (RA)* Vol 2, Pt 1, Ch 2,17.

Section 3

Character of Classification and Class notations

3.11.3.2 Tailoring – Departures from the Rules and Rule additions

3.11.4 3.2.1 In general, there are different levels of deviation from the Rules:

- (a) Interpretations are applied where strict compliance with a Rule requirement cannot be achieved but where the proposed arrangement clearly satisfies the intent of the Rules. The decision to apply an interpretation is at LR's discretion and will be recorded in design appraisal documentation.
- (b) Exceptions or concessions are non-compliances with Rule requirements where LR is satisfied that the arrangements presented are an acceptable alternative to its Rules on the basis of ~~a technical justification~~ **an Engineering and Safety Justification Report**. Exceptions are normally raised by the designer or Builder and are to be agreed with the Owner and ~~Naval Authority~~ **Naval Administration**.
- (c) Alternatives are deviations which represent a significant change to the Rule requirements. They may involve the use of an alternative standard to replace a Rule Chapter. In such cases, the **(NS)** character is to be appended to the notation, see ~~3.2.5~~ **3.3.5**. LR is to be satisfied that the arrangements are an acceptable technical alternative. Alternatives are normally raised by the designer or Builder and are to be agreed with the Owner and ~~Naval Authority~~ **Naval Administration**. A tailoring document or ~~design statement~~ **System Design Description** is required to define the alternative proposal in advance of design appraisal.

~~3.11.2~~ **3.2.2** Tailoring is to be agreed between LR and the ~~Naval Authority~~ **Naval Administration**. Where a departure from the Rules is not agreed by LR, an exemption is required from the ~~Naval Authority~~ **Naval Administration** at Board level.

~~3.11.3~~ **3.2.3** Additions may involve the use of a standard in addition to the LR Rule requirements. In such cases, the **(NS)** character is to be appended to the notation, see 3.2.5. Additions are normally raised by the designer or Builder and are to be agreed with the Owner and ~~Naval Authority~~ **Naval Administration**. A tailoring document or ~~design statement~~ **System Design Description** is required to define the addition in advance of design appraisal.

~~3.11.4~~ **3.2.4** ~~A Technical~~ **An Engineering and Safety** justification is to be provided for each deviation from the Rule requirements, see 2.2.17. ~~In some cases a full justification and Risk Assessment may be required. See Requirements for Machinery and Engineering Systems of Unconventional Design, Vol 2, Pt 1, Ch 5 and Risk Assessment (RA) Vol 2, Pt 1, Ch 2,17.~~

~~3.11.5~~ **3.2.5** At the design stage, departures from the Rules or additional requirements may be captured in a tailoring document developed by the designer. Tailoring is defined as the process by which specific requirements of a standard, specification or similar document are selected and used to meet the needs of a project. The tailoring document should cover subjects such as:

- (a) Additional standards;
- (b) Additional ~~client requirements~~ **requirements of the Naval Administration or the Owner**;
- (c) Additional designer requirements;
- (d) Interpretations;
- (e) Exceptions/non-compliances against Rules;
- (f) Exceptions/non-compliances against other defined standards or design policies;
- (g) Equipment and component procurement.

The tailoring document should clearly define the paragraphs of the Rules which are modified, what alternative requirements are to be used and reference to the **technical justification Engineering and Safety Justification**, where appropriate. The tailoring document is to be submitted with the plans at the time of appraisal and referenced in appraisal documentation.

3.2.6 At the build and through-life stages, significant non-compliances, alternative or additional requirements will be recorded by LR as exceptions, using appropriate documentation. They will be clearly defined and referenced in the Classification Certificates and any associated registers.

3.2.3.3 Character symbols

Existing paragraphs 3.2.1 to 3.2.4 have been renumbered 3.3.1 to 3.3.4.

3.3.5 The Navy or Naval Authority may specify alternative or additional standards relating to the application of a character symbol or Class notation may be specified. Where these alternative or additional standards have been agreed by LR and the Naval Administration, a formal process for approval, construction, testing and verification throughout life has been established, this feature will be recognised by the addition of **(NS)** to a character symbol or Class notation. See also **3.2**. The alternative or additional requirements of the Navy or Naval Authority are to be clearly defined and referenced in the Classification Certificates and any required registers such as the register of lifting appliances. The following are examples of character symbols and Class notations that may recognise Navy or Naval Authority requirements as they may appear in the vessel's Classification record alternative or additional standards:

- A(NS)** Ship built or accepted into Naval Class in accordance with LR's Rules and Regulations for assignment of the **A** character and defined Navy or Naval Authority requirements additional specified requirements, see 3.2.5 and 3.3.5.
- ⌘LMC(NS)** Propelling and essential auxiliary machinery constructed, installed and tested under Special Survey in accordance with LR's Rules and Regulations for assignment of **⌘LMC** Class notation and defined Navy or Naval Authority requirements additional specified requirements, see 3.2.5 and 3.3.5.
- LA(NS)** Lifting appliances designed and built in accordance with an agreed standard equivalent to LR's *Code for Lifting Appliances in a Marine Environment (LAME)* or equivalent standard for assignment of **LA** Class notation and additional defined requirements of the Navy or Naval Authority.
- FIRE(NS)** Fire protection functional requirements are in accordance with LR's requirements for assignment of **FIRE** Class notation and additional requirements of the Navy or Naval Authority specified fire safety requirements, see 3.2.5 and 3.3.5.

3.3.6 Proposals to apply the additional Navy or Naval Authority recognition symbol **(NS)** to a character symbol or Class notation are to be made to LR with details of the Navy or Naval Authority requirements the standard, see 3.2.5 and 3.3.5, together with proposed processes for approval, construction, testing and verification throughout life.

Existing sub-Section 3.3 has been renumbered 3.4.

3.4.3.5 Ship type notations

Existing paragraphs 3.4.1 to 3.4.5 have been renumbered 3.5.1 to 3.5.5.

3.5.6 NS3 vessels:

- (a)** For vessels being built to the **NS3** notation, the following shall apply where the vessel is also being designed and built to comply with appropriate statutory regulations for the intended service of the vessel.
- (ba)** LR is to be contracted to issue Statements of Compliance with the nominated statutory regulation. Appropriate statutory regulations may include, but are not limited to:
 - (i) International Convention for the Safety of Life at Sea.
 - (ii) Code of Safety for Special Purpose Ships (SPS Code).
 - (iii) UK MCA Small Commercial Vessel and Pilot Boat (SCV) Code or similar recognised regulation or National Standard.
- (eb)** Vessels are to be certified for Intact and Damaged Stability, and Carriage of Munitions by a Recognised Organisation. Other statutory requirements such as compliance with the International Convention for the Prevention of Pollution from Ships should also be issued by a recognised Organisation.
- (ec)** Details of required certification are to be submitted to LR at the time of contracting. Form 2506 is to be used for this information.
- (ed)** Where a vessel is so contracted, the following aspects of the Rules for Naval Ships will be exempted for the requirements of Classification:

All requirements for a **Naval Authority Naval Administration** to agree the contents of:

 - (i) Concept of Operations Document(s).
 - (ii) Design Statements.
 - (iii) Other aspects as wherever referred to in the Rules are not applicable.
- (fe)** The requirements of Pt 5, Ch 4,6.1.4 are to be complied with.
- (gf)** The limits of the Operating Envelope to which the hull structure has been approved, are to be displayed prominently in the wheelhouse.
- (hg)** Where a vessel is to be Classed using this approach, any exemptions are to be agreed by the **Naval Authority Naval Administration** and justified by using the approach set out in Vol 2, Pt 1, Ch 5, *Requirements for Machinery and Engineering Systems of Unconventional Design*.

Existing sub-Sections 3.5 and 3.6 have been renumbered 3.6 and 3.7.

3.7 3.8 Military Distinction notations

(Part only shown)

~~3.7.1~~ 3.8.1 Military Distinction notations may be assigned if a particular feature relating to military loads has been incorporated in the design. The requirements for all the Military ~~distinction~~ Distinction notations are given in Part 4.

✕ MD This ~~military distinction~~ Military Distinction notation will be assigned when military aspects of the ship have been constructed under LR's Special Survey and in accordance with LR's Rules and Regulations.

✕ MD This ~~military distinction~~ Military Distinction notation will be assigned when military aspects of the ship have been constructed under LR's Special Survey in accordance with plans approved by the ~~Naval Authority~~ Naval Administration in accordance with Rules and Regulations equivalent to those of LR.

MD This ~~military distinction~~ Military Distinction notation will be assigned when military aspects of the ship have been assessed by the ~~Naval Authority~~ Naval Administration in accordance with the Rules and Regulations equivalent to those of LR.

Existing sub-Section 3.8 has been renumbered 3.9.

3.9 3.10 Other notations

(Part only shown)

~~3.9.1~~ 3.10.1 LAP. This optional special feature Class notation will be assigned to the ship in respect of the lifting appliances fitted which are designed and built in accordance with LR's Code for Lifting Appliances in a Marine Environment (LAME) or equivalent standard, but where it is not mandated by the LA notation, see 3.9.2. This notation will be assigned in association with a register of lifting appliances listing the appliances covered. The register, which is to be attached to the Classification Certificate, is the responsibility of the ~~designer/Owner~~ Owner and should include the following lifting appliances, where fitted as appropriate:

Existing paragraphs 3.9.2 to 3.9.24 have been renumbered 3.10.2 to 3.10.24.

Existing sub-Section 3.10 has been deleted in its entirety.

■ Section 4

Surveys – General

4.1 New construction

4.1.5 # Where requested, LR will check the intact and damage stability calculations and approve the Stability information in accordance with a standard acceptable to the ~~Naval Authority and LR~~ in accordance with the agreed standard(s).

(Part only shown)

4.1.8 Life-Saving and Evacuation – LSAE

The arrangements for life-saving and evacuation are to be examined to ensure that the following life-saving and evacuation objectives have been satisfied:

- (a) **Evacuation Objective.** Arrangements are to be provided to enable personnel to evacuate the ship safely and in a time acceptable to the ~~Naval Authority~~ Naval Administration.

4.3 Existing ships

4.3.1 Classification of ships not built under LR survey.

The requirements of LR for the Classification of ships which have not been built under LR's Survey are indicated in Ch 3,16. Special consideration will be given to ships that have been designed, constructed and maintained to ~~appropriate specified standards recognised by the Naval Authority~~ appropriate specified standards, and to ships transferring Class to LR from another recognised Classification Society who have appropriate Naval Ship Rules.

4.4 Damages, repairs and alterations

4.4.5 When at any survey it is found that any damage, defect, or breakdown (see 1.1.7) is of such a nature that it does not require immediate permanent repair, but is sufficiently serious to require rectification by a prescribed date in order to maintain Class, a suitable Condition of Class is to be imposed by the Surveyors and recommended for consideration. This condition may be designated as an operational defect, under the Owner's control, but LR needs to be kept advised as to proposed actions. The technical impact of any deficiency on the operational needs of the ship must be considered by the ~~surveyor~~ Surveyor in liaison with the Owner/~~Naval Authority~~ before a decision is made with regard to corrective action.

4.4.8 Plans and particulars of any proposed alterations (Mods. or A's and A's) to the approved scantlings and arrangements of the hull, machinery and engineering systems are to be submitted by the Owners ~~or Builders~~ or their representatives for approval by LR and such alterations are to be carried out to the satisfaction of LR's Surveyors.

4.5 Existing ships – Periodical Surveys

~~4.5.22 — Where the ship is fitted with a dynamic positioning system, the system is to be examined and tested annually in accordance with the requirements of Ch 3,2.3.15. In addition a Special Survey is to be carried out at intervals not exceeding five years in accordance with Ch 3,7.2.9.~~

Section 6

Classification of machinery with [X]LMC or MCH notation

6.2 Appraisal and records

6.2.1 To facilitate survey and compilation of classification records, the same plans and information that are required for a ship being accepted into class with the [X]LMC notation, are required to be submitted for the alternative notation [X] LMC or MCH for appraisal and information. Plans are not required where machinery and equipment has have previously been type approved, in by LR. In these cases it is only necessary to submit details of the machinery and equipment together with details of the previous approval.

6.3 Survey and inspection

6.3.1 The manufacturer's certificate for acceptance of machinery and equipment for assignment of the [X]LMC or MCH notation is to be in the English language and include the following information:

- Design and manufacturing standard(s) used.
- Materials used for construction of key components and their sources.
- Details of the quality control system applied during design, manufacture and testing, and of any software maintenance.
- Details of any type approval or type testing.
- Details of installation and testing recommendations for the machinery or equipment.

The manufacturer is to have a recognised quality management system certified by an IACS member or a Notified Body.

6.3.3 Acceptance of manufacturer's certificates for items of machinery for propulsion (including propulsion gearing with single input/output arrangements) and for electrical power generation and for other auxiliary machinery for essential services where the [X] LMC notation is to be assigned, is subject to the following conditions:

- The vessel is an NS3 ship or an NS4 ship or an NSA ship of less than 500 gross tonnage or is a ship of 500 gross tonnage or greater and is not required to comply with international conventions applicable to a ship with unrestricted service.
- The design and manufacture standards for all machinery and associated systems are the applicable LR Rules.
- The machinery and equipment are manufactured under a quality control system which is in accordance with a recognised National or International Standard for such systems that is acceptable to LR.
- Propellers, propulsion shafting and multiple input/output gearboxes are not included within the scope of propulsion arrangements for acceptance of a manufacturer's certificate.

6.3.4 Acceptance of the manufacturer's certificate for propelling and essential auxiliary machinery, where the MCH notation is to be assigned, is subject to the following conditions:

- The ship is an NS3 ship or an NS4 ship or an NSA ship of less than 500 gross tonnage or is a ship of 500 gross tonnage or greater and is not required to comply with international conventions applicable to a ship with unrestricted service.
- The power of any engine or gas turbine is less than 2,250 kW and the cylinder bore of any diesel engine is not greater than 300 mm.
- The design standards for machinery and associated systems are the applicable LR Rules or other marine standards acceptable to LR.
- The machinery and equipment is manufactured under a recognised quality control system that is acceptable to LR.

Section 9

Classification of naval ships using alternative LR's Rules

9.1 General

9.1.1 Where it is proposed to class a naval ship with materials of construction and operating parameters not addressed within the scope of the Naval Ship Rules, then the appropriate elements of other LR Classification Rules may be used where agreed between the Naval Authority, the Navy, Builder and LR, as agreed in the Tailoring Document, see 3.11.1.

Volume 1, Part 1, Chapter 3

Periodical Survey Regulations

Effective Date 1 January 2015

■ Section 1

General

1.2 Surveys for damage or alterations

1.2.2 This examination should normally be carried out by a Surveyor, and the Owners/~~Naval Authority~~ should give as much notice as possible to LR so that arrangements can be made for attendance. In the absence of a Surveyor, due to the unforeseen nature of the removal, the Owner is to carry out a suitable examination and report the findings to LR as soon as practicable.

1.5 Definitions

1.5.2 **Enclosed space** is any place of an enclosed nature where there is a risk of death or serious injury from hazardous substances or dangerous conditions. Examples include, but are not limited to: boilers, pressure vessels, cargo spaces (cargo holds, or cargo tanks), cargo space stairways, ballast tanks, double bottoms, double hull spaces, fuel oil tanks, lube oil tanks, sewage-tanks, pump-rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases, excavations and pits.

Existing paragraphs 1.5.2 to 1.5.11 have been renumbered 1.5.3 to 1.5.12.

1.6 Preparation for survey and means of access

~~1.6.1 — Tanks and spaces are to be safe for access, i.e., gas freed, ventilated and illuminated.~~

~~1.6.2 — In preparation for survey, thickness measurements and to allow for a thorough examination, all spaces are to be cleaned including removal from surfaces of all loose accumulated corrosion scale. Spaces are to be sufficiently clean and free from water, scale, dirt, oil residues, etc., to reveal corrosion, deformation, fractures, damages or other structural deterioration. However, those areas of structure whose renewal has already been decided by the Owner need only be cleaned and de-scaled to the extent necessary to determine the limits of renewed areas.~~

~~1.6.3 — Sufficient illumination is to be provided.~~

~~1.6.4 — Means are to be provided to enable the Surveyor to examine the structure in a safe and practical way.~~

1.6.1 In order to enable the attending Surveyor(s) to carry out surveys, provisions for safe access and for survey are to be agreed between the Owner and LR.

1.6.2 Means are to be provided to enable the Surveyor to examine the structure in a safe and practical way. Where the provisions of safety and required access are determined by the Surveyor not to be adequate, then the survey of the space(s) involved is not to proceed.

1.6.3 Spaces are to be made safe for access and survey and are to be sufficiently cleaned, illuminated and ventilated.

1.6.4 In preparation for survey, thickness measurements and to allow for a thorough examination, cleaning is to include removal from surfaces of all loose accumulated corrosion scale. Spaces are to be sufficiently clean and free from water, scale, dirt, oil residues, etc., to reveal corrosion, deformation, fractures, damages or other structural deterioration, as well as the condition of the protective coating. However, those areas of structure whose renewal has already been decided by the Owner need only be cleaned and descaled to the extent necessary to determine the limits of renewed areas.

1.6.5 Where soft or semi-hard coatings have been applied, safe access is to be provided for the Surveyor to verify the effectiveness of the coating and to carry out an assessment of the conditions of internal structures which may include spot removal of the coating. When safe access cannot be provided, the soft or semi-hard coating is to be removed.

1.6.6 Prior to entering an enclosed space, it is to be verified by a competent person using a calibrated multi gas meter that the atmosphere in that space is free from hazardous gas and contains sufficient oxygen.

1.6.7 Emergency equipment and personnel are to be available in case of an emergency or rescue operation.

1.6.8 Information on procedures, equipment operating instructions and safety checklists is to be available.

1.6.9 During the survey, ventilation is to be ensured and periodic testing is to be carried out as necessary to verify that the atmosphere remains safe for access.

Existing paragraphs 1.6.5 and 1.6.6 have been renumbered 1.6.10 and 1.6.11.

1.8 Thickness measurement at surveys

1.8.2 Further to the requirements of 1.6.6 a survey planning meeting is to be held between the attending Surveyor(s), the Owner's/~~Navy's~~ representative and the thickness measurement firm's representative, so as to ensure the safe and efficient execution of the surveys and thickness measurements to be carried out on board.

■ Section 2 Annual Surveys – Hull, machinery and optional requirements

2.3 Machinery

~~2.3.15 On ships fitted with a dynamic positioning system, the control system and associated machinery items are to be generally examined and tested to demonstrate that they are in good working order.~~

Existing paragraphs 2.3.16 to 2.3.18 have been renumbered 2.3.15 to 2.3.17.

■ Section 7 Machinery survey – General requirements

7.2 Complete Survey

~~7.2.9 For ships fitted with a dynamic positioning system, the control system and associated machinery items are to be examined and tested under operating conditions to an approved Test Schedule.~~

Existing paragraphs 7.2.10 and 7.2.11 have been renumbered 7.2.9 and 7.2.10.

■ Section 10 Electrical equipment

10.2 Complete Surveys

10.2.11 Where the ship is electrically propelled, the propulsion motors, generators, propulsion transformers, propulsion conversion equipment, cables, harmonic filters, neutral earthing resistors, dynamic braking resistors and all ancillary electrical gear equipment that forms part of the propulsion drive and control system, exciters and ventilating plant (including coolers) associated therewith are to be examined surveyed, and the insulation resistance to earth is to be tested. Special attention is to be given to windings, commutators and sliprings. Where practicable, the low voltage and high voltage windings of cast resin coated propulsion transformers are to be subjected to boroscopic inspection, to assess the physical condition of their insulation and for signs of mechanical and thermal damage. The operation of protective gear and alarm devices is to be checked, so far as is practicable. Insulating oil, if used, is to be tested in accordance with 10.2.7. Interlocks intended to prevent unsafe operations or unauthorised access are to be checked to verify that they are functioning correctly. Emergency overspeed governors are to be tested.

■ Section 13 Screwshafts, tube shafts and propellers

13.1 Frequency of surveys

~~13.1.8 Dynamic positioning and/or thruster assisted Thruster-assisted mooring and athwartship thrust propellers and shaftings are to be surveyed at intervals not exceeding six years.~~

13.2 Normal surveys

~~13.2.4 Dynamic positioning and/or thruster assisted Thruster-assisted mooring and athwartship thrust propellers are to be generally examined so far as is possible in dry dock. All accessible parts, including sealing, locking and bearing faces and any other moving parts should be examined. Non-destructive examination should be carried out as considered necessary by the surveyor on blade/fin roots. Consideration may be given to appropriate condition monitoring scheme data for determining the condition of the unit whilst in afloat condition.~~

■ Section 15 Machinery planned maintenance and condition monitoring, MPMS, MCM and RCM

15.4 Basic requirements for approval of MPMS, MCM and RCM schemes

15.4.3 The following information is to be submitted to LR for review:

- (a) Hard or soft copy (with operating systems if necessary) of the studies, conducted in accordance with a relevant National or International Standard, such as ISO 17359, *Condition monitoring and diagnostics of machines – General guidelines*. This is to include operating context, details of study team, Risk Assessment (RA, see also Pt 1, Ch 2,17), algorithm decision sheets, summary of maintenance tasks, summary of 'level of repair analysis', identification of 'critical' spares.
- (b) Details of system/equipment covered by the study.
- (c) ~~Copy of acceptance letter from equipment manufacturer confirming their review of the study details.~~ Confirmation that maintenance studies have included where possible, OEM data on failure rates, OEM maintenance recommendations, and associated information necessary to ensure that risk associated with component failure is accounted for accurately.

Volume 1, Part 3, Chapter 1

General

Effective Date 1 January 2015

■ Section 1

Rules application

1.5 Interpretation

1.5.2 Attention is drawn to the fact that Codes of Practice issued by IMO contain requirements which are outside classification as defined in these Rules. Whilst they ~~will~~ **may** not be mandatory for naval ships they ~~may~~ **will** be adopted ~~as identified by the Naval Authority~~ when specified.

■ Section 5

Definitions

5.2 Principal particulars

(Parts only shown)

5.2.1 ~~Length waterline, L_{WL}~~ **Length waterline, L_{WL}** , is the distance, in metres, measured on a waterline at the design draught from the fore side of the stem to the after side of the stern or transom as shown in Fig. 1.5.1.

5.2.2 ~~Rule length, L_R~~ **Rule length, L_R** , is the distance, in metres, on a waterline at the design draught from the forward side of the stem to the after side of the rudder post or to the centre of the rudder stock if there is no rudder post.

5.2.4 ~~Length between perpendiculars, L_{PP} , in metres~~ **Length between perpendiculars, L_{PP}** , is the distance, in metres, on the waterline at the design draught from the forward to the after perpendicular.

5.2.5 ~~The forward perpendicular, F.P.~~ **Forward perpendicular, F.P.**, is the perpendicular at the intersection of the waterline at the design draught with the fore side of the stem.

5.2.6 ~~The after perpendicular, A.P.~~ **After perpendicular, A.P.**, is the perpendicular at the intersection of the waterline at the design draught with the after side of the rudder post or to the centre of the rudder stock for vessels without a rudder post or to the intersection with the transom profile on the centreline.

5.2.7 ~~Length overall, L_{OA}~~ **Length overall, L_{OA}** , is the distance, in metres, measured parallel to the deep load waterline from the fore side of the stem to the after side of the stern or transom, excluding rubbing strakes and other projections as shown in Fig. 1.5.1.

5.2.8 ~~Waterline breadth, B_{WL}~~ **Waterline breadth, B_{WL}** , is generally the greatest moulded breadth, in metres, measured at the design draught, as shown in Fig. 1.5.2.

5.2.9 ~~Breadth, B~~ **Breadth, B** , is generally the greatest moulded breadth, in metres, throughout the depth of the ship or as defined in appropriate Chapters. For vessels of unusual cross-section the breadth will be specially considered.

5.2.10 ~~Depth, D~~ **Depth, D** , is measured, in metres, at amidships, from top of keel plate to the moulded deck line at side on the uppermost continuous deck, or as defined in appropriate Chapters or standards. When a rounded gunwale is arranged, the depth D is to be measured to the continuation of the moulded deck line at side.

5.2.11 ~~Draught, T~~ **Draught, T** , is the design draught, in metres, measured from moulded baseline.

5.2.12 ~~Block coefficient, C_b~~ **Block coefficient, C_b** , is the block coefficient at draught T corresponding to a waterline at the design draught, based on Rule length L_R and breadth B_{WL} , as follows:

$$C_b = \frac{\text{moulded displacement (m}^3\text{) at draught } T}{L_R B_{WL} T}$$

5.2.13 Design draught may be determined from the waterline when the vessel is in a deep condition plus any specified margins. ~~In special circumstances, the operation of the vessel or the Owner's specification may require that~~ Where specified a higher waterline **may** be used.

5.11 Extent of watertight subdivision

5.11.1 The minimum extent of watertight subdivision (internal), and integrity (internal and external), ~~shall be such that it satisfies the requirements of the Navy. The standard of watertight subdivision and integrity shall be defined by the Navy or its nominated Naval Authority~~ is to be in accordance with the specified subdivision and stability standard(s).

5.11.4 For the calculation of watertight structural scantlings the pressure head is to be taken from the vertical limits of weathertightness determined by either intact or damage stability considerations ~~determined by~~ in accordance with the specified subdivision and stability standard(s), see Ch 2,1.3 ~~or the Naval Authority, see~~ and Pt 5, Ch 3,5.5.

■ Section 6

Building tolerances and associated repairs

6.1 Overview

6.1.2 Tolerances to be used for constructional misalignment for all materials are to be discussed between Owners/Builders and the Surveyor and ~~acceptable the~~ Standards agreed subject to the requirements of 6.1.1 ~~or~~

~~National Authority requirements where applicable.~~ The permitted degree of inaccuracy/misalignment will vary according to whether the defect is:

- (a) In primary structure.
- (b) In secondary structure.
- (c) Equipment supporting structure or underwater plate near acoustic equipment.
- (d) Aesthetically pleasing.

Volume 1, Part 3, Chapter 2

Ship Design

Effective Date 1 January 2015

■ Section 1 General

1.1 Application

1.1.3 These Rules are to be applied with reference to the operational conditions defined in the Concept of Operations, see Pt 1, Ch 2.2.2.

1.2 Definitions

1.2.2 The minimum required angle of down flooding, θ_{df} , is to be taken as 40° except when a higher minimum angle is required by the stability and subdivision standard specified by the Naval Authority in accordance with the specified subdivision and stability standard(s), see Pt 1, Ch 2.1.1.9.

1.3 Watertight and weathertight integrity

(Part only shown)

1.3.3 Damage stability

1.3.3.4 In the absence of specific information on the vertical limit of watertight integrity, the upper extent of the watertight boundary may be assumed with the apex of the triangle on the damage control deck nominated by the Naval Authority at the location under consideration, see Fig. 2.1.2 and Pt 3, Ch 1.5.4.4.

1.5 Residual Strength Assessment, RSA

1.5.4 A residual strength assessment performed as defined in the Rules, assumes that a ship can remain operational for a limited period of time in reduced sea states, see Pt 6, Ch 4.1.2. Where a Naval Authority wishes to maintain a high higher operational capability following damage is specified, special consideration will need to be given and revised criteria will be set.

1.5.5 The Owner may specify an alternative mission statement, in which case the requirements of the residual strength assessment procedure are to satisfy the Owner's definition will be modified.

■ Section 2 Rule structural concept

2.2 Scantlings

2.2.8 Structure in way of Replenishment at Sea, RAS, positions, cranes, heavy lift route points, weapon handling, etc., are to be designed in accordance with Pt 4, Ch 1.5. The equipment is to be designed in accordance with the requirements of the Naval Authority a specified standard(s), see Vol 1, Pt 1, Ch 2.1.1.

■ Section 3 Main hull structure

3.6 Double bottom structure

3.6.2 Double bottoms are in general to be fitted in NS1 ships and are to extend from the collision bulkhead to the aft peak bulkhead, as far as this is practicable within the design and proper working of the ship. The specified subdivision and stability standard specified by the Naval Authority adopted in accordance with 1.3 may contain additional requirements for the height and extent of the double bottom.

3.7 Deck structure

3.7.23 The Naval Authority The specified subdivision and stability standard(s) may require type approval of all watertight deck penetration glands to all deck penetrations to be of a nominated standard.

■ Section 4 Bulkhead arrangements

4.1 General

4.1.4 Bulkheads forming the boundaries to citadels and zones as defined in Pt 4, Ch 1.7, other than watertight bulkheads, are usually required by the Naval Authority specified to be gastight. See also 4.7. Where specifically required by the Naval Authority specified, LR can assess the gastight integrity of defined gastight boundaries, see Pt 6, Ch 6.6.8.

4.1.6 The Naval Authority The specified subdivision and stability standard(s) may require type approval of all watertight bulkhead penetration glands to all bulkhead penetrations to be of a nominated standard.

4.2 Number and disposition of watertight bulkheads

4.2.1 In general, the number and disposition of bulkheads are to be arranged to suit the requirements for subdivision, floodability and damage stability, and are to be in accordance with ~~Naval Authority requirements as defined in 1.3~~ the specified subdivision and stability standard(s).

4.3 Collision bulkheads

4.3.3 No accesses or ventilation ducts are to be fitted in collision bulkheads. In particular designs where it would be impracticable to arrange access to the fore peak other than through the collision bulkhead, access may be permitted if ~~acceptable to the Naval Administration specified~~. Where accesses are provided, the openings are to be as small as practicable and positioned as far above the design waterline as possible, in any event, no lower than the damage control deck. Access is to be by manholes with bolts spaced at a watertight pitch.

4.3.4 Pipe runs or cable runs are only to be fitted in the collision bulkhead ~~where approved by the Naval Administration~~ if specified in the subdivision and stability standard(s).

4.10 Watertight tunnels and passageways

4.10.1 Sterntubes are to be enclosed in watertight spaces of moderate volume. In addition, arrangements are to be made to minimise the danger of water penetrating into the ship in case of damage to the stern tube ~~in accordance with the requirements of the Naval Authority~~. Normally the stern gland is to be situated in a watertight shaft tunnel or other watertight space separate from the stern tube compartment and of such volume that, if flooded by leakage through the stern gland, the vertical limit of watertight integrity, see 1.3, will not be submerged.

4.11 Means of escape

4.11.1 The arrangement of the hull is to be such that all under deck compartments are as accessible as practicable and provided with a satisfactory means of escape in accordance ~~with a recognised Naval Authority~~ with a specified standard(s). Access and escape hatches to the machinery and tanks are not to be obstructed by deck coverings or furniture.

Section 5 Fore and aft end arrangements

5.3 Minimum bow height and extent of forecastle

5.3.1 The requirements regarding minimum bow height given in 5.3.2 are to be complied with. Only in exceptional circumstances and in specialist ships will any relaxation be given to this requirement where it interferes with the safe operation of the vessel. In such cases, due consideration is to be

given to the clearing of ~~sea water~~ seawater from the forecastle deck. The effects on strength and stability are also to be considered.

5.3.2 All sea-going ships are to be fitted with forecastles, or increased sheer on the upper deck or equivalent, such that the distance from the waterline design draught to the top of the exposed deck at side at the F.P. is not less than:

$$H_b = \left(6075 \left(\frac{L_R}{100} \right) - 1875 \left(\frac{L_R}{100} \right)^2 + 200 \left(\frac{L_R}{100} \right)^3 \right) \times \left(2,08 + 0,609C_b - 1,603C_{wf} - 0,0129 \left(\frac{L_R}{d_1} \right) \right)$$

where

C_b = block coefficient, ~~not to be less than 0,68~~

L_R = Rule Length, in metres

H_b = minimum bow height, in mm

d_1 = draught at 85 per cent of the depth, D , see Ch 1,5.2.10

C_{wf} = waterplane area coefficient forward of midships $A_{wf}/\{(L_R/2) \times B\}$

B = moulded breadth, in metres

A_{wf} = is the forward waterplane area at draught d_1 , in m².

5.3.3 Ships shall have additional reserve of buoyancy in the fore end region to ensure sufficient longitudinal righting energy to recover from bow immersion in a seaway and be designed to prevent the excessive shipping of green seas.

Existing paragraphs 5.3.3 and 5.3.4 have been renumbered 5.3.4 and 5.3.5.

Volume 1, Part 3, Chapter 3

Ship Control Systems

Effective Date 1 January 2015

Section 2

Rudders

2.20 Lowest main bearing requirement Rudder stock and bearings

2.20.1 The design of the lowest bearing is to comply with the requirements of Table 3.2.9. Bearings are to comply with the requirements of Table 3.2.9. The fitting of bearings is to be carried out in accordance with the manufacturer's recommendations to ensure that they remain secure under all foreseeable operating conditions.

Table 3.2.9 Lowest main bearing Bearing requirements

Item	Requirement	
Lowest main bearing Bearing Length	Depth Z_B , in mm $1,5d_s \geq Z_B \geq 1,0d_s$	Minimum thickness of wall, in mm lessor of $0,2d_s$ or 100
Main bearing wall thickness	The lesser of $0,2d_s$ or 100 mm (see Note 1)	
Bearing pressure (on the projected area of the lowest main bearing), where the projected area is to be taken as the length x diameter)	Bearing material	Maximum pressure, in N/mm ² (see Note 4 Note 2)
	Metal Synthetic	7,0 5,5
Clearance in lowest main bearing on the diameter (note should be taken of the manufacturer's recommended clearances, particularly where bush material requires pre-soaking)	Bearing material	Minimum clearance, in mm (see Note 3)
	Metal (see Note 2 Note 4) Synthetic (see Note 5)	$0,001d_s + 1,0$ $0,002d_s + 1,0$ but not less than 1,5
Symbols		
d_s = stock diameter, given by 2.15.2, in mm		
NOTES 1. Where web stiffening is fitted on the bearing, a reduction in wall thickness will be considered. 2. For bearings which are pressure lubricated the clearance must be restricted to enable the pressure to be maintained. 2. Proposals for higher pressures or other materials will be specially considered on the basis of satisfactory test results. 3. Value of proposed minimum clearance is to be indicated on plans submitted for approval. 4. Proposals for higher pressures or other materials will be specially considered on the basis of satisfactory test results. 4. For bearings which are pressure lubricated the clearance must be restricted to enable the pressure to be maintained. 5. If non-metallic bearing material is applied, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties. This clearance is not to be taken less than 1.5 on bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance.		

Volume 1, Part 3, Chapter 4

Closing Arrangements and Outfit

Effective Date 1 January 2015

■ Section 1 Introduction

1.1 General

1.1.1 The requirements of this Chapter are applicable to all ship types. If required, reference should be made to any additional or alternative standards that are specified by the Naval Authority which will also be considered. Details are to be submitted the specified subdivision and stability standard(s).

■ Section 2 Hatches and miscellaneous openings on the weather deck

2.1 Hatch covers

2.1.2 Weather-tight or gastight hatches (CBRN) should be located on lower decks in accordance with requirements as specified by the Naval Authority, see Pt 4, Ch 1. Consideration should be given to positioning weather-tight or gastight hatches on lower decks in accordance with a specified standard for CBRN purposes.

2.3 Manholes and flush escape hatches

2.3.2 Flush escape hatches are to be closed by substantial weather-tight covers capable of being opened and closed from either side except for unless specified otherwise for hatches that provide access to high security areas such as magazines or to prevent access from open decks as agreed with the Naval Authority. The covers are to be permanently attached.

■ Section 4 Watertight doors and hatches in watertight subdivision boundaries

4.1 General

4.1.3 Where watertight doors of the sliding type are permitted to be fitted by the Naval Administration by the subdivision and stability standard, they are to be capable of being operated by efficient hand-operated gear, both at the door itself and from an accessible position above the vertical limit of watertight integrity. Means are to be provided at the remote operating position to indicate whether the door is open or closed. The time necessary for the complete closure of the door, when operating by hand gear, is not to exceed 90 seconds with the ship in the upright position.

4.1.7 Watertight doors and hatches are to be capable of being operated from both sides of the watertight division except for access to high security areas such as magazines or to prevent access from open decks as agreed with the Naval Administration.

4.1.8 As a minimum, sliding Sliding watertight doors are to be capable of being operated when the ship is listed up to the heel and trim angles specified in the subdivision and stability standard, but not less than 15° heel either way. The Naval Administration may require that the doors are operable up to the angles of heel determined by the damage stability calculations. Consideration is also to be given to the forces which may act on either side of the door as may be experienced when water is flowing through the opening, applying a static head equivalent to a water height of at least 1 m above the sill on the centreline of the door.

■ Section 5 Side lights scuttles and windows

5.1 General

5.1.1 Side lights, portlights and portholes are considered to be side scuttles.

Existing paragraphs 5.1.1 and 5.1.2 have been renumbered 5.1.2 and 5.1.3.

5.1.3 5.1.4 A plan showing the location of side lights scuttles and windows is to be submitted.

5.1.4 5.1.5 Side lights scuttles and windows together with their glasses and deadlights if fitted, are to be of an approved design or in accordance with recognised Naval Authority requirements a specified standard(s).

5.1.5 5.1.6 Side lights scuttles to spaces within enclosed superstructures, or deckhouses on or above the weather deck are to be fitted with efficient, hinged, inside deadlights and capable of being effectively closed and secured watertight.

5.1.6 5.1.7 All side lights scuttles are to be of the non-opening type.

5.1.7 5.1.8 Windows should not generally are not to be fitted below the lowest weather deck or in end bulkheads of superstructures.

Existing paragraph 5.1.8 has been renumbered 5.1.9.

5.1.9 5.1.10 Side lights scuttles and windows set inboard from the shell on the weather deck, protecting direct access below, are either to be provided with strong permanently attached deadlights or, where they are accessible, strong permanently attached external steel storm covers instead of internal deadlights.

~~5.1.10~~ 5.1.11 Side ~~lights~~ scuttles and windows set inboard from the shell on the weather deck, not protecting direct access below, do not require deadlights or storm covers.

~~5.1.11~~ 5.1.12 Cabin bulkheads and doors are considered to provide effective protection between side ~~lights~~ scuttles or windows and access below.

■ Section 6 Ventilators

6.1 Application

6.1.1 This Section applies to all ship types and provides requirements for ventilators. Reference should be made to ~~any additional or alternative standards that are specified by the Naval Authority which will also be considered the specified subdivision and stability standard(s). Details are to be submitted.~~

6.4 Coamings

6.4.2 The height of ventilator coamings may be required to be increased on ships where this is shown to be necessary by the stability and watertight subdivision calculations required by ~~Pt 1, Ch 1, 1.1 the specified subdivision and stability standard(s), see Pt 1, Ch 2, 1.1.9. The Naval Authority specified standard may require that the height of all ventilator coamings are above the θ_{eff} angle of down flooding, see Ch 1, 1.2 2, 1.2.~~

6.6 Machinery spaces

6.6.2 Where due to ship size and arrangement this is not practicable, lesser heights for machinery space ventilator coamings fitted with weathertight closing appliances may be permitted ~~by the Naval Authority if specified~~ in combination with other suitable arrangements to ensure uninterrupted, adequate supply of ventilation to these spaces.

■ Section 7 Air pipes

7.2 Height of air pipes

7.2.3 The height of air pipes may be required to be increased on ships where this is shown to be necessary by the stability and watertight subdivision calculations required by Pt 1, Ch 1, 1.1. An increase in height may also ~~by required or recommended by Naval Authorities be required~~ when air pipes to fuel oil and settling tanks are situated in positions where sea water could be temporarily entrapped, e.g., in recesses in the sides and ends of superstructures or deck-houses, between hatch ends, behind high sections of bulwark, etc.,. This may entail an increase in tank scantlings, see also Pt 6, Ch 3.

■ Section 9

Bulwarks, guard rails, raised walkways and other means for the protection of crew and embarked personnel

9.1 General requirements

9.1.1 Bulwarks or guard rails are to be provided at the boundaries of exposed decks. Bulwarks or guard rails are to be not less than 1,0 m in height measured above sheathing, and are to be constructed as required by this Section. Consideration will be given to cases where this height would interfere with the normal operation of the ship. Guard rails provided around aircraft operating areas may be of the type which drop outwards with nets ~~to the satisfaction of the Naval Administration,~~ provided access is restricted to essential personnel. Where bulwarks or rails are undesirable, e.g., for radar signature purposes, alternative equivalent arrangements will be required.

9.5 Walkways

9.5.1 Walkways are to be designed to an ~~appropriate National or International Standard agreed with LR and the Naval Authority agreed specified standard.~~

9.5.3 The design loads used are to be as given in Pt 5, Ch 3, 5.3.1. Where it is intended that the walkway be used for the transfer or storage of equipment or other substantial items, the design loads are to be agreed ~~between LR and the Naval Authority~~ considering the loads given in Pt 5, Ch 3, 5.3.1.

■ Section 11 Lifting eyes

11.3 Materials

11.3.1 Materials are to be in accordance with an ~~appropriate Standard agreed between LR and the Naval Authority agreed specified standard.~~

11.4 Lifting points

11.4.1 Lifting eyes are to be manufactured in accordance with an ~~appropriate Standard agreed between LR and the Naval Authority agreed specified standard.~~

Volume 1, Part 3, Chapter 5

Anchoring, Mooring, Towing, Berthing, Launching, Recovery and Docking

Effective Date 1 January 2015

■ Section 4 Anchors

4.1 General

4.1.5 Where there is a high degree of redundancy in propulsion and steering and where the engine can be brought to readiness quickly, consideration may be given to the fitting of a single anchor where Table 5.4.1 requires the fitting of two anchors, where acceptable to the Naval Authority.

4.1.8 Where ships are required by the Naval Authority to be fitted with kedge anchors Where kedge anchors are specified, they are to be in accordance with Table 5.6.1.

■ Section 6 Mooring ropes

6.6 Support structure of deck fittings

6.6.3 The design load to be applied to the supporting structure of mooring fittings is to be 1,25 times the minimum breaking strength of the mooring line according to Table 5.6.1 for the ship's corresponding equipment number. If a greater design load is specified by the Naval Authority this load is to be used.

■ Section 7 Towing arrangements

7.2 Application

7.2.8 Where alternative requirements of the Navy or Naval Authority relating to the breaking load of the towing hawser required by Pt 3, Ch 5, 7.6.1 are specified, and have been complied with, the ship will be entitled to the notation **TA(NS)**. These alternative requirements are to be clearly defined and referenced in the Certificate of Class. The load specified in the alternative is to replace the BL value given by the expression in 7.6.1.

7.6 Strength requirements for towing arrangements

7.6.2 The strength of other loose towing equipment, e.g., links, shackles rings and chafing chain is to be determined on the basis of a design load equal to 1,25 times the *BL* of the towing hawser. If a greater design load is specified by the Naval Authority this load is to be used.

7.6.3 The strength of shipboard fittings and their supporting structure is to be determined on the basis of a design load equal to 1,25 times the *BL* of the towing hawser.

If a greater design load is specified by the Naval Authority this load is to be used. The design load is to be applied through the towline according to the arrangement shown on the towing arrangement plan. The point of action of the force on the fitting is to be taken as the point of attachment of the mooring line or towline or at a change in its direction. The total design load applied to a fitting need not be more than twice the design load, see Fig. 5.7.1.

Volume 1, Part 3, Chapter 6

Structural Procedures for the Design, Construction and Lifetime Care of Ships

Effective Date 1 January 2015

■ Section 4
Construction Monitoring

4.2 Identification of critical areas

4.2.4 In addition, critical areas may be identified by the designer, ~~Naval Authority~~ Naval Administration or Owner from one of the following:

- (a) Known areas of high stress identified by structural engineers;
- (b) Areas that have experienced failure on similar ships in service;
- (c) Structures with specific alignment requirements; e.g., masts, shaft brackets.

4.2.7 It is recommended that the areas for Construction Monitoring be identified and the criteria developed in a workshop with the ~~designer~~ Owner, Naval Administration, Builder, ~~Naval Authority~~ and LR.

Volume 1, Part 4, Chapter 1

Military Design

Effective Date 1 January 2015

■ Section 1

General requirements

1.1 General

1.1.3 Information is classified in two types. Firstly, design guidance for which further approval has to be sought once a suitable standard is identified by the Naval Authority specified, and secondly, design requirements which have to be met as part of the ~~100A1~~ notation or a specific notation such as LA(N).

1.3 Signature

1.3.4 Special features notations for signature control will not normally be assigned. Some of the above features will form part of the Naval Ship notation ~~100A1 NS~~ and are detailed in Section 3. ~~If requested by the Owner a descriptive note can also be assigned.~~

■ Section 2

Survivability

2.1 General

2.1.3 The **concept phase** is not normally part of classification and is a discussion between the Owner, ~~Naval Authority~~ Naval Administration, designer and those specialists able to perform the appropriate calculations. It is used to identify the potential threats, requirements for the ship structure, machinery and systems with respect to those threats.

(Part only shown)

2.1.4 The **concept phase** will apply all of the elements shown in Fig. 1.2.1:

- (a) Identification of the threat is first and this is usually determined by the Naval Authority for current and future threats. Several threats will be identified which affect the ship in a variety of ways, they may be underwater or above water, far field, close in, or contact weapons. Typical threat groups are given in Table 1.3.1.

2.1.9 It is the responsibility of the ~~Naval Authority~~ Naval Administration to ensure that each of the phases is implemented, to define the requirements that are to be met and advise the Owner on the manner in which particular threats can be dealt with.

2.2 Vulnerability

2.2.4 The methods used to control the spread of fire will have an effect on structural design, materials, fire insulation, fire divisions and openings, and must all be considered. One method used to control the spread of fire is zones and some

guidance on the philosophy and structural requirements is provided in Section 7. However, the precise requirements for fire detection, protection and extinction are ~~to be defined by the Naval Authority~~ to be provided in the specified fire safety standard(s). Where this is examined by LR in accordance with Pt 1, Ch 2,3.9.7 a **FIRE** notation may be assigned. Other methods include the use of smoke tight boundaries, insulation and fire-fighting systems.

2.2.5 The stability of a vessel and flooding following damage is not covered in this Chapter. The ~~specified subdivision and stability standard, nominated by the Naval Authority,~~ will should define the extent of damage that the vessel is required to survive and remain stable. All structure and watertight closing appliances will need to be assessed to this level. Pt 3, Ch 1,5 defines how the minimum extent of watertight subdivision is to be determined. Pt 3, Ch 4 contains details on requirements for closing appliances. For such an extreme event as flooding, plastic type analysis is appropriate for watertight structure and this is recognised in the relevant rule requirements.

2.2.13 It is the responsibility of the Owner to ~~decide~~ specify the levels at which these should be set. In theory, they could be made to be coincident but this would provide little reserve within the vessel for recovery by damage control and repair. Conversely, they should not be set too far apart as this represents unnecessary armament and strengthening which is not effectively protecting the equipment and machinery from attack.

■ Section 3

Military distinction notations

3.1 General

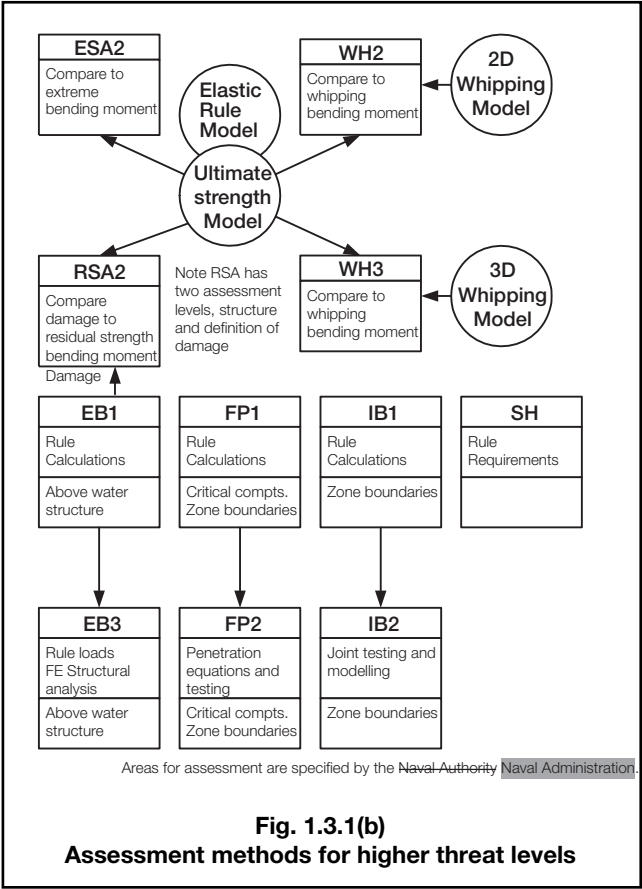
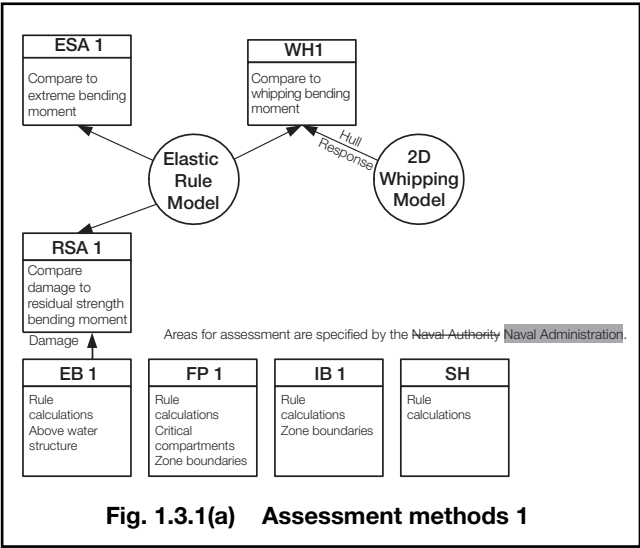
3.1.3 Unless specifically requested these notations will be assigned at an appropriate level which will remain confidential to the Owner. It is the responsibility of the Owner to ~~determine~~ specify the threat levels suitable for their requirements. The agreed threat levels will not appear in the *Register Book* or be published in any other form. Only the notation ~~MD~~ will be used to show that some military features have been incorporated and constructed in accordance with LR's *Rules and Regulations for the Classification of Naval Ships*.

(Part only shown)

Table 1.3.1 Relationship between notations

Symbols	
R	= Required threats to be considered in the absence of a specific requirement.
O	= Optional threats to be identified by the Naval Authority Owner and dependent on the characteristic of the threat.
NOTES	
1.	It remains the responsibility of the Owner to determine the appropriate military notation and the appropriate levels of threat and analysis.
2.	For nuclear threats, consideration should be given to CBRN requirements for structure, see Section 7, filtration and ventilation. The ability of the structure to screen an electromagnetic pulse should also be considered.

3.4 Analysis levels



Section 4
Military design guidance

4.1 Radar signature

4.1.4 Appropriate modelling tools and expert judgement should be used for RCS calculation and assessment at various stages of the design iteration. Use of these tools and judgement should be agreed between the Owner and designer. Consideration should also be given to the RCS measurement of equipment.

Section 5
Military design requirements

5.1 RAS seating and support structure

5.1.2 The seating and supporting structure is to be tested in accordance with Naval Authority requirements a specified standard, see also Vol 3, Pt 1, Ch 5,3.1.4. Care is to be taken to ensure that the test arrangements represent the actual magnitude and direction of loads, and that the loading is applied to all relevant parts of the supporting structure rather than local items only.

5.1.5 RAS equipment is to be designed in accordance with the requirements of the Naval Authority a specified standard, see also Pt 1, Ch 2,2.2.6 and Vol 3, Pt 1, Ch 5,3.1.4.

5.3 Masts and externally mounted sensors or equipment

5.3.7 Suitable permanent access arrangements are to be provided inside and on the exterior of the mast for maintenance of the structure and equipment. Provision is to be made for the drainage of water from all parts of the mast, both internal and external. Where applicable, protective coatings are to be applied in accordance with the requirements of Pt 6, Ch 6,2.6. ~~In certain cases an increased corrosion allowance (e.g., at the mast base) should be considered. For corrosion margins, see Pt 6, Ch 6,2.10.~~

5.4 Towed arrays, towed bodies and towing points

5.4.3 Towed array handling equipment is to be designed in accordance with ~~the requirements of the Naval Authority, see Pt 1, Ch 2,2.2.6~~ a specified standard. The seating of array handling equipment is to be adequately supported.

5.5 Crane support arrangements

5.5.2 The scantlings of masts and derrick posts, intended to support derrick booms, conveyor arms and similar loads, and of crane pedestals are to be designed in accordance with ~~the requirements of the Naval Authority, see Pt 1, Ch 2,2.2.6~~ a specified standard. When submitting plans for the proposed foundation, the design calculations are to be included.

■ Section 6 Magazine design and construction

6.1 General

6.1.1 The design, construction and maintenance of magazines are to be in accordance with ~~Naval Authority Regulations~~ the specified magazine safety standard, see Pt 1, Ch 2,1.1.13. All Regulations, recommendations and requirements are to be confirmed to have been applied. ~~See Pt 1, Ch 2,1.1.13.~~

6.1.2 Where ~~Naval Authority Regulations are not specified~~ standards have not been specified the following requirements apply. A Risk Assessment, in accordance with Vol 2, Pt 1, Ch 2,17, may be used to justify alternative arrangements. This is to be approved by the ~~Naval Authority or organisation acting on the Naval Authority's behalf~~ Owner and Naval Administration. All recommendations and requirements are to be demonstrated to have been applied.

■ Section 7 Design guidance for nuclear, biological and chemical defence

7.1 General

7.1.1 The arrangements of hull structure for chemical, biological, radiological and nuclear defence (CBRN) are to generally be in accordance with the requirements of this Section. The final design and arrangements are to be in accordance with ~~the requirements of the Naval Authority~~ a specified standard. Where specifically requested, LR can undertake the inspection and certification of CBRN arrangements or gas tight integrity, see Pt 6, Ch 6,6.8.

7.3 NS1 and NS2 ship requirements

7.3.1 The requirements of this Section deal only with the hull structure and mainly involve the arrangement of major divisions within the hull. Provision is to be made within the layout and design of the ship for the compartments required for CBRN defence. ~~As a consequence~~ It is recommended that they are ~~to be~~ considered from a very early stage in the design ~~and in consultation with the Naval Authority, Owner, designer and LR.~~

7.3.2 Unless specified otherwise ~~required by the Naval Authority~~, the citadel's length is to be divided into zones. It is recommended that the zone boundaries coincide with main transverse watertight bulkheads and extend from the keel to the highest superstructure deck.

7.4 NS3 ship requirements

7.4.1 The requirements of this Section deal only with the hull structure and mainly involve the arrangement of major divisions within the hull. ~~As a consequence~~ It is recommended that they are ~~to be~~ considered from a very early stage in the design ~~and in consultation with the Naval Authority, Owner, designer and LR.~~

Volume 1, Part 4, Chapter 2

Military Load Specification

Effective Date 1 January 2015

■ Section 1

General requirements

1.1 General

~~1.1.4 The notations that are applicable for a particular ship are to be agreed between the builder or designer, Owner, Naval Authority and LR as defined in Chapter 1.~~

■ Section 5

Underwater explosion (shock)

5.2 Threat level determination

~~5.2.1 The level of threat required is to be specified by the Owner. The actual threat level used in the calculation of performance and the areas of the ship to be protected by this design method are to be specified by the Owner and will remain confidential to LR.~~

5.3 Notation assessment methodology

(Part only shown)

~~5.3.1 The shock performance required is to be agreed between specified by the Owner, the Naval Authority and the Shipbuilder. The agreement and is to include requirements for:~~

5.3.3 For ships where the machinery is in class (LMC notation), ~~if the Naval Authority has identified and shock requirements for machinery and equipment are specified, the requirements of Vol 2, Pt 1, Ch 2,4.11 are also to be complied with.~~

5.3.5 For the assignment of the **SH** notation, the minimum requirement is for the structure to be designed to resist normal environmental loads in accordance with the Rules. For **NS1** ships the inherent ruggedness in the Rules is sufficient for the structure to resist a low level threat. For **NS2** and **NS3** ships the integrity of the hull plate and stiffeners is to be verified, using the simple formulae for pressure in 5.4.1, and comparing the response to ~~an acceptance standard nominated by the Naval Authority~~ a specified standard. In addition, the hull valves below the waterline are to comply with the requirements of 5.8.

5.4 Local strength assessment

(Part only shown)

5.4.1 For the notation **SH**, a simple analysis can be performed which allows the motion response at any point in the ship to be determined. This can be derived from experimental results or the Taylor plate equations given below. Once

the motion response is known, the damage potential can be determined by comparing the response to ~~an acceptance a specified standard nominated by the Naval Authority:~~

5.6 Seat design

5.6.1 The shock notation may be enhanced by specifying that some or all of the equipment seating is to be designed to resist shock loading. Seats design should take account of the acceleration and deceleration from the shock wave; the magnitude of the shock acceleration will depend on the equipment mass, position in the ship and mounting arrangements. The seat design methodology is to be ~~agreed with the relevant Naval Authority~~ in accordance with a specified standard. The selection of seats to be assessed will depend on the equipment supported and the compartment in which it is situated.

5.6.2 Minor seats should be assessed to ensure that equipment remains captive. Detail design requirements such as minimum thickness, alignment, and free edge support can be specified to improve shock performance. In the absence of information ~~from the Naval Authority~~, minor seats can be considered as those with equipment mass below 100 kg.

(Part only shown)

~~5.6.4 The shock accelerations are to be agreed between the Owner, designer and Naval Authority, specified by the Owner. In general, accelerations will be specified for the following regions of the ship:~~

5.7 Shock mounts

(Part only shown)

5.7.1 All shock mounts are to be of an approved type. Approval is to be undertaken by organisations approved by the ~~Naval Authority~~ Naval Administration. Approval documentation should contain the following information in accordance with NATO document ANEP63:

5.8 Design guidance for hull valves, piping and seals

(Part only shown)

5.8.1 Hull valves below the waterline are to be of an approved type. Approval is to be undertaken by organisations approved by the ~~Naval Authority~~ Naval Administration. Approval documentation should contain the following:

5.8.9 Recognised semi-empirical methods may be used to assess the valve ~~and should be agreed between the Owner, the Naval Authority and the Shipbuilder.~~

■ Section 6 Whipping

6.2 Threat level determination

6.2.1 The level to which a ship will be expected to survive an attack scenario that excites hull whipping is to be defined specified by the Owner and will remain confidential to LR.

■ Section 8 Strengthening requirements for beach landing operations

8.1 General

8.1.1 These requirements are in addition to those of Pt 6, Ch 3 for bottom shell structure. They need only be applied to those areas of the hull at risk from grounding during beach landing operations. These areas are to be agreed between the Owner, Builder and LR with LR at an early stage in the plan approval process. A distinction is made between those areas likely to see impact loads on beaching and those where contact due to grounding will occur after the initial beaching.

■ Section 9 Military installation and operational loads

9.2 Replenishment at sea loads

9.2.2 Guidance on representative arrangements is presented in Fig. 2.9.3. It is the responsibility of the Owner to define specify the design load values. The line of action of the forces is to be considered for all possible angles that might occur during replenishment operations.

■ Section 10 Aircraft operations

10.1 General

10.1.8 Suitable fire-fighting equipment and services should be arranged on the landing deck, manoeuvring and parking areas as defined by the Naval Authority, in accordance with the specified fire safety standard. Arrangements are to be made for drainage of the platform, including drainage of spilt fuel. Fire protection should also be arranged between spaces containing aircraft and other areas of the ship. Special consideration should be given to aircraft handling arrangements and the possible passage of spilt fuel.

10.8 Deck plating design

10.8.11 For steel decks in frequent use and where no suitable protective sheathing or coating is used, it is recommended that the thickness of the plating is to be increased by 1.5 mm to allow for wear and corrosion, see Pt 6, Ch 6, 2.10.

Volume 1, Part 4, Chapter 3
Special Features

Effective Date 1 January 2015

■ *Section 2*
Vehicle decks and fixed ramps

2.7 Access

2.7.3 Doors providing access between vehicle decks and accommodation spaces are to be gastight, have scantlings equivalent to the surrounding structure and where applicable are to comply with ~~the fire requirements as defined by the Naval Authority~~ the specified fire safety standard.

■ *Section 3*
Bow doors

3.2 General

3.2.1 The attention of Owners and Builders is drawn to the additional statutory regulations for bow doors that may be required by ~~the Naval Authority~~ the subdivision and stability standard.

■ *Section 5*
Movable decks, lifts, internal and external ramps

5.1 Classification

5.1.1 ~~At the Owner's or Builder's request~~ Where required by the LA Notation, see Vol 1, Pt 1, Ch 2,1.1.12 or specified by the Owner, movable decks will be included as a classification item, ~~and the class notation Movable decks will be entered in the Register Book.~~ In such cases, all movable decks on board the ship are to comply with the requirements of this Section.

5.1.3 The operating and securing equipment or machinery is to be in accordance with ~~the requirements of the Naval Authority, see Pt 1, Ch 2,2.2.6~~ all specified standards.

5.3 Loading

5.3.6 Decks, ramps or lifts and their supporting structure are to be designed for the maximum load that is to be carried; this may include loadings from emergency situations where they are ~~defined~~ specified by the Owner.

Volume 1, Part 5, Chapter 2

Environmental Conditions

Effective Date 1 January 2015

■ Section 2

Wave environment

2.2 Service areas

2.2.7 ~~The~~ It is the responsibility of the Owner ~~or Builder~~ ~~should confirm~~ to determine that the chosen Service Area, the service area factor, f_s , and the wave environment characteristics as defined in 2.3 are appropriate for the intended areas of operation.

■ Section 4

Guidance for ice environment

4.1 General

4.1.2 ~~The~~ It is the responsibility of the Owner ~~is to confirm~~ to determine which notation is most suitable for their requirements. Ultimately the responsibility rests with the commanding officer and their assessment of the ice and temperature conditions at the time.

4.6 Ice accretion

4.6.6 The effects on stability of ice accretion are to be assessed in accordance with the ~~specified subdivision and stability standard identified by the Naval Authority.~~

4.6.7 Where alternative icing allowances are specified ~~by the Naval Authority~~ and these allowances exceed that defined in 4.6.3 and 4.6.5 for the appropriate operational areas, these allowances shall be used in the assessment of the local and global structure.

Volume 1, Part 5, Chapter 3

Local Design Loads

Effective Date 1 January 2015

Section 1 Introduction

1.3 Symbols and definitions

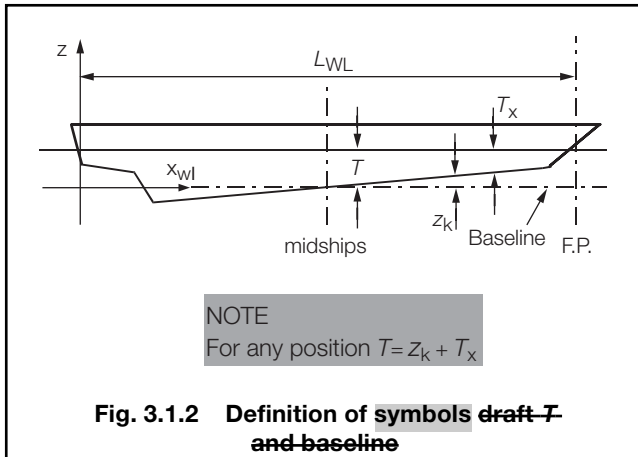


Fig. 3.1.2 Definition of symbols draft T and baseline

1.3.8 Support girth G_S . The support girth is the girth distance at the LCG, in metres, and is to be calculated as follows:

- For craft with chines, it is to be taken as the distance around the shell plate between the girth chine locations, see Fig. 3.1.3. Girth chine location is to be taken as the lowest chine above which the shell plate has an angle to the horizontal greater than 50° .
- For craft where the design waterline intercepts the shell plate below the bilge tangential point or the girth chine location, the support girth is to be taken as the distance around the shell plate up to the design waterline, see Fig. 3.1.4.
- For craft with round bilges, it is to be taken as the distance around the shell plate between the bilge tangential points of the hull. The bilge tangential point is defined as the tangential point of the bilge with an oblique line sloped at 50° to the horizontal at the LCG, see Fig. 3.1.5.
- For multi-hull craft, it is to be taken as the summation of girths for each individual hull between the inner and outer bilge tangential points or chines, as appropriate.

The definition aims to define the canoe body. Narrow keels and skegs can be ignored.

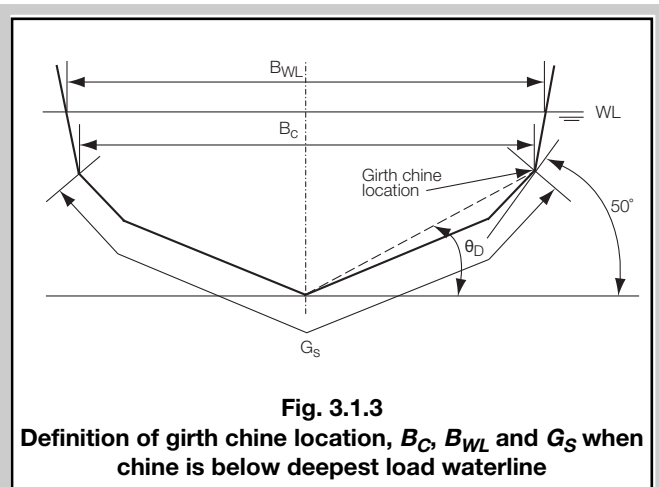


Fig. 3.1.3 Definition of girth chine location, B_C , B_{WL} and G_S when chine is below deepest load waterline

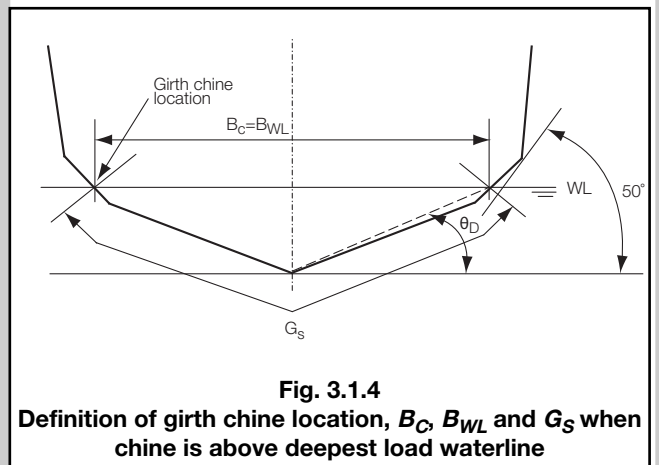


Fig. 3.1.4 Definition of girth chine location, B_C , B_{WL} and G_S when chine is above deepest load waterline

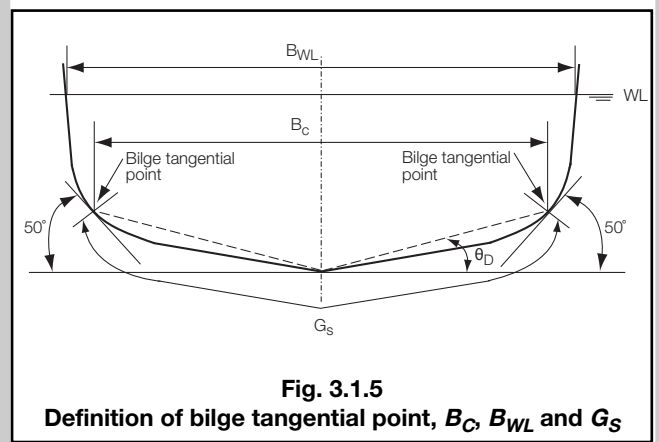


Fig. 3.1.5 Definition of bilge tangential point, B_C , B_{WL} and G_S

Section 2

Motion response

2.4 Design vertical acceleration for ships in the planing regime

(Parts only shown)

2.4.2 The non-dimensional vertical acceleration at the LCG, a_{op} , is defined as the average of the 1/100 highest accelerations and is to be taken as:

B_c = breadth of hull between the chines or bilge tangential points at the LCG, as appropriate, in metres, see Fig. 3.2.1

θ_D = deadrise angle at the LCG, in degrees, but is not to be taken as greater than 30°, see Notes 1 and 2 and Fig. 3.2.1 3.1.5

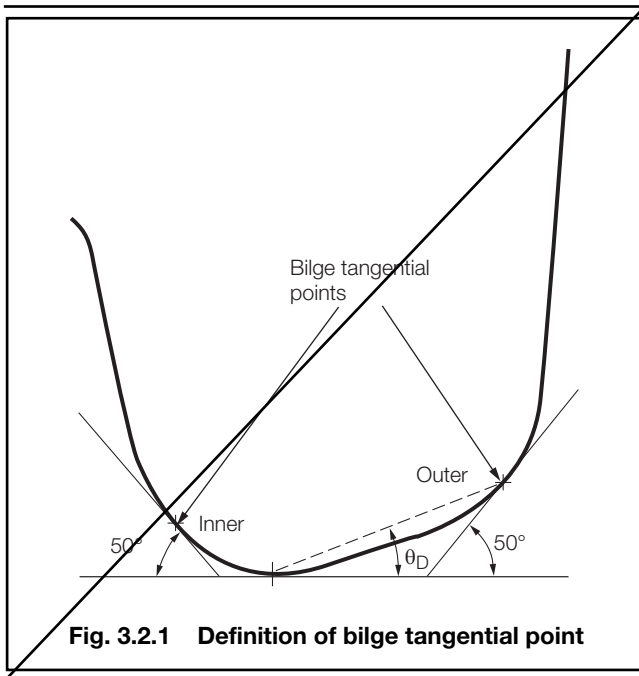
B_{WL} and L_{WL} are defined in 1.3.1

LCG is defined in 1.3.4

B_{WL} and L_{WL} are defined in Pt 3, Ch 1, 5.2

NOTES

- 1 The bilge tangential point is defined as the tangential point of the bilge with an oblique line sloped at 50° to the horizontal at the LCG, see Fig. 3.2.1.
- 2 For ships with no clearly defined deadrise angle at the LCG, the angle, in degrees, to the horizontal line at the LCG formed by joining the lowest point of the hull or underside of keel and the bilge tangential point is to be taken as the deadrise angle θ_D , see Fig. 3.2.1 3.1.5.
- 3 For ships with hulls of asymmetric section, where the inner and outer deadrise angles differ, the smaller of the two angles is to be used.



Section 4

Impact loads on external plating

4.5 Bottom impact pressure for ships operating in the planing regime

(Part only shown)

4.5.1 The equivalent static bottom impact pressure due to slamming, P_{dl} , at the LCG for mono-hull planing hull forms is given by the following expression:

$$P_{dl} = \frac{k_{dl} \Delta f_{dl} (1 + a_{op})}{L_{WL} G_o} \text{ kN/m}^2$$

$$P_{dl} = \frac{k_{dl} \Delta f_{dl} (1 + a_{op})}{L_{WL} G_s} \text{ kN/m}^2$$

where

G_s = support girth or girth distance, in metres, as defined in Table 3.4.1 1.3.8

Table 3.4.1 Definition of G_o for the determination of bottom impact pressure, P_{dl} , for different regions

Bottom shell region	G_o	
	Hull forms with chines	Hull forms without chines
Between tangential points or chines	G_s	G_s
Between tangential points and design waterline	—	G_{WL}

NOTES

- G_s = support girth, in metres. This is the girth distance measured between the bilge tangential points or chines at the LCG. The bilge tangential point is defined as the point where a line 50° above the horizontal touches the bilge plating, see Fig. 3.2.1.
- G_{WL} = girth distance, in metres, measured between the waterlines on either side of a hull at the LCG.

Section 5

Local design loads for decks and bulkheads

5.3 Pressure on internal decks, P_{in}

5.3.3 The hydrostatic design pressure for decks specified as watertight by the Naval Authority shall be taken as that determined by the damage stability analysis and limit of watertight integrity.

5.10 Design loads for RSA notation assessment

5.10.2 Where ~~the Naval Authority requires~~ watertight boundaries for damage control purposes are specified in the subdivision and stability standard, the nominated bounding decks are to be assigned as watertight boundaries, see Pt 6, Ch 3,10. The pressure heads used in the assessment of damage control decks are to be the greater of that determined from the Rules or that specified by the ~~Naval Authority~~ Owner.

■ *Section 6*
Other local loads

6.3 Loads for windows and side lights scuttles in the shell envelope, P_{wi}

Volume 1, Part 5, Chapter 4

Global Design Loads

Effective Date 1 January 2015

■ Section 3

Global hull girder loads

3.3 Vertical wave bending moments

(Part only shown)

3.3.3 The bow flare area, A_{BF} , is illustrated in Fig. 4.3.1 and may be derived as follows:

$T_{C,U}$ is a waterline taken $L_f/2$ m above the design draught

$$T_{C,U} = T + \frac{L_f}{2} \text{ m}$$

(Part only shown)

3.3.4 The stern flare area, A_{SF} , is illustrated in Fig. 4.3.1 and is to be derived as follows:

$T_{C,L}$ is a waterline taken $L_f/2$ m below the design draught

$$T_{C,L} = T - \frac{L_f}{2} \text{ m}$$

■ Section 4

Extreme hull girder loads

4.3 Extreme vertical wave bending moments

4.3.4 ~~Where requested~~ **If specified** by the Owner, the extreme hogging and sagging vertical wave bending moment or extreme scaling factor, K_{fEX} , may be derived from long-term 'in-service' measurements from a series of ships with similar hull forms, mass distributions and areas of operation.

Volume 1, Part 6, Chapter 1
General

Effective Date 1 January 2015

■ Section 2
General requirements

2.2 Plans to be submitted

2.2.1 Plans are to be of sufficient detail for plan approval purposes. For all areas of structure listed below the submitted plans are to show all plating thickness, stiffeners sizes and spacings, bracket arrangements and connections. Where appropriate, the plans should clearly show the allowance for corrosion margin or ~~Owner's extra~~ enhanced scantlings. Welding, constructional arrangements and tolerances are also to be submitted and this may be in the form of a booklet.

2.5 Enhanced scantlings

2.5.1 Where scantlings in excess of the approved Rule requirement are fitted at defined locations as corrosion margins or for other purposes, ~~as specified by the Owner,~~ a notation **ES**, 'Enhanced Scantlings', will be assigned and it will be accompanied by a list giving items to which the enhancement has been applied and the increase in scantling. For example, the item 'bottom shell (strakes A, B, C, D) +2' will indicate that an extra 2 mm has been fitted to the bottom shell of the ship for the particular strakes listed, see also Ch 6,2.10. In addition the plans submitted for approval are to contain the enhanced scantling plan, together with the nominal thickness, less the enhancement adjacent, in brackets.

Volume 1, Part 6, Chapter 2
Design Tools

Effective Date 1 January 2015

■ *Section 3*
Buckling

3.1 General

3.1.4 The buckling requirements are to be met using the net scantlings, hence any additional thickness for corrosion margin or Owners extra enhanced scantlings is not included in the scantlings used to assess the buckling performance. For enhanced scantlings, see Pt 3, Ch 6,6. For corrosion margins, see Pt 6, Ch 6,2.10.

Volume 1, Part 6, Chapter 3

Scantling Determination

Effective Date 1 January 2015

■ Section 1 General

1.3 Direct calculations

1.3.1 The extent of direct calculation required will depend on the ship's structural configuration and operational requirements and is to be agreed between the designer, Owner, Naval Administration and Lloyd's Register (hereinafter referred to as 'LR') at an early stage in the plan approval process.

■ Section 2 Minimum structural requirements

2.2 Corrosion margin

2.2.1 The minimum thicknesses given in Table 3.2.1 are based on the assumption that the correct coatings are used and a proper maintenance regime is employed such that there is negligible loss in strength by due to corrosion. Where this is not the case the minimum thickness will be specially considered. Requirements for For corrosion margins, are given in see Pt 6, Ch 6,2.10.

■ Section 3 NS1 scantling determination

3.1 General

3.1.2 The scantlings given in this Section are based on the assumption that the correct coatings are used and a proper maintenance regime is employed such that there is negligible loss in strength by due to corrosion. For corrosion margins, see Ch 6,2.10.

~~3.1.3 The corrosion margins specified in Ch 6,2.10 are to be applied to the derived scantlings as appropriate, see also Ch 1,2.2.1.~~

■ Section 4 NS2 and NS3 scantling determination

4.1 General

4.1.5 The scantlings in this Section are based on the assumption that the correct coatings are used and a proper maintenance regime is employed such that there is negligible loss in strength from due to corrosion. For corrosion margins, see Ch 6,2.10.

~~4.1.6 The corrosion margins specified in Ch 6,2.10 are to be applied to the derived scantlings as appropriate, see also Ch 1,2.2.1.~~

■ Section 7 Single bottom structures

7.1 General

7.1.5 Watertight girders and floors or girders and floors forming the boundaries of tank spaces are to comply with the requirements for watertight bulkheads and deep tanks as detailed in Section 9. ~~Consideration should be given to the addition of a corrosion margin in excess of that specified in~~ For corrosion margins, see Ch 6,2.10.

■ Section 8 Double bottom structures

8.1 General

8.1.6 Where a floor, girder or inner bottom plating forms the boundary of a tank or part of the watertight subdivision, the requirements of Section 9 for deep tanks and watertight bulkheads are to be complied with. ~~Consideration should be given to the addition of a corrosion margin in excess of that specified in~~ For corrosion margins, see Ch 6,2.10.

■ Section 15 Strengthening for wave impact loads above waterline

15.1 General

15.1.3 The scantling requirements contained in this Section are based on no permanent set of plating. If acceptable to the Owner, special consideration will be given to an alternative plating performance ~~specification standard~~ where specified. Areas designed in accordance with an alternative performance specification are to be clearly marked on the plans. Direct calculations may be used to determine the required scantlings.

Volume 1, Part 6, Chapter 4

Hull Girder Strength

Effective Date 1 January 2015

■ Section 1 General

1.2 Hull girder strength notations

1.2.1 The following notations are available for all ships with regard to global hull girder strength aspects:

- **ESA1, ESA2** Extreme strength assessment.
- **RSA1, RSA2, RSA3** Residual strength assessment.

A distinction is made between levels of performance and levels of assessment; the numeral in the notation reflects the level of assessment. Levels of performance are denoted by the letters A, B, C for collision or grounding damage and numerals I, II and III for damage from military threats and are confidential to the Owner. See 4.2 for non-military threats and Pt 4, Ch 2,7 for military threats.

1.2.7 Three assessment and performance levels are available for the residual strength assessment notation. **RSA1**, the assessment Level 1 residual strength assessment, and performance level A ~~is are~~ recommended as a minimum for all ships of groups **NS1** and **NS2**. However, it is the responsibility of the Owner to specify the level of residual strength assessment required.

■ Section 2 Hull girder strength

2.6 Buckling strength

2.6.2 When a Level 2 extreme strength assessment is applied, the Owner may specify ~~in the tailoring document~~ that the buckling assessment of plate panels subject to compressive stresses is not required. In this case the buckling requirements of Ch 2,3.3 may be relaxed. The requirements of Ch 2,3.6 for shear buckling and the remainder of Ch 2,3 must always be complied with.

■ Section 4 Residual Strength Assessment, RSA

4.2 Extent of damage and analysis

4.2.1 The extent of damage to be considered is defined below. Unless otherwise ~~stipulated specified~~ by the Owner it will not be necessary to consider the consequences of combining damage extents from different weapon threats or damage scenarios.

4.3 Determination of critical sections

4.3.3 For Level 1 and 2 residual strength assessments, damaged areas are to be considered at approximately the longitudinal positions $L_R/4$, $L_R/2$ and $3L_R/4$. The geometric properties of critical transverse sections in way of these damaged areas are to be considered. Other longitudinal positions may also need to be considered depending on the internal arrangement or structural arrangement of the ship or the ~~Owner's required specified~~ residual strength ~~specification~~ requirements.

Volume 1, Part 6, Chapter 6

Material and Welding Requirements

Effective Date 1 January 2015

■ Section 1

General

1.4 Builder's facilities

1.4.1 The buildings used for production and storage are to be of suitable construction and equipped to provide the required environment, and are also to comply with any local or Naval Authority requirements specified standard(s).

■ Section 2

Materials

2.2 Grade of steel

(Part only shown)

Table 6.2.1 Material classes and grades in general

Structural member category	Material class/minimum grade
PRIMARY	
B1. Bottom plating, including keel plate B2. Strength deck plating, excluding that belonging to the Special category B3. Continuous longitudinal plating of strength members above strength deck B4. Uppermost strake in longitudinal bulkhead	Class II within $0,6L_R$ amidships Grade A/AH outside $0,4L_R$ amidships
SPECIAL	
C4. Bilge strake in ships with double bottom over the full breadth and length less than 150 m; ~~see Note 1~~	Class II within $0,6L_R$ amidships Class I outside $0,6L_R$ amidships
ADDITIONAL REQUIREMENTS FOR SINGLE STRENGTH DECK SHIPS OF LENGTH GREATER THAN 150 m	
~~D1. Longitudinal strength members of strength deck plating~~ D1. Longitudinal plating of strength deck where contributing to the longitudinal strength D2. Continuous longitudinal plating of strength members above strength deck	Grade B/AH within $0,4L_R$ amidships
~~D2. Continuous longitudinal strength members above strength deck~~	~~Grade B/AH within $0,4L_R$ amidships~~
NOTES	
- Single strakes required to be of Class III or of Grade E/EH and within $0,4L_R$ amidships are to have breadths not less than $800 + 5L_R$ mm, but need not be greater than 1800 mm, unless limited by the geometry of the ship's design. - For strength members not mentioned, Grade A/AH may be generally used. - Steel grade is to correspond to the as-fitted thickness. - Plating materials for sternframes supporting the rudder and propeller boss, rudders, rudder horns and shaft brackets are, in general, not to be of lower grades than corresponding to Class II. For rudder and rudder body plates subjected to stress concentrations (e.g., in way of lower support of semi-spade rudders or at upper part of spade rudders) Class III is to be applied. - RAS seating and support structure are to be of Grade D/DH for $t \leq 20$ mm and Grade E/EH for $t > 20$ mm. For ships operating in cold weather RAS seating and support structure are to be of Grade E/EH. - Corner inserts in way of complex openings such as for lifts and side doors which may impinge on the deck plating or stringer plate are to be of Grade D/DH for $t \leq 20$ mm and Grade E/EH for $t > 20$ mm. - The material class used for reinforcement and the quality of material (i.e., whether mild or higher tensile steel) used for welded attachments, such as waterway bars and bilge keels, is to be similar to that of the hull envelope plating in way. Where attachments are made to rounded gunwale plates, special consideration will be given to the required grade of steel, taking account of the intended structural arrangements and attachment details. - The material class for deck plating, sheerstrake and upper strake of longitudinal bulkhead within $0,4L_R$ amidships is also to be applied at structural breaks of the superstructure, irrespective of position. - Engine seat top plates outside $0,6L_R$ amidships may be Grade A/AH. Steel grade requirement for top plates within $0,6L_R$ amidships will be specially considered.	

Table 6.2.3 **Grades of steel for refrigerated spaces
with a minimum design temperature
below 0°C**

Minimum design temperature, in °C	Thickness, in mm	Grades of steel
0 to -10	$t \leq 12,5$ $12,5 < t \leq 25,5$ $t > 25,5$	B/AH D/DH E/EH
~~-10 to -25~~ -10 to -25	$t \leq 12,5$ $t > 12,5$	D/DH E/EH
~~-25 to -40~~ -25 to -40	$t \leq 12,5$ $t > 12,5$	E/EH FH/LT-FH (see also Ch 3,6 of the Rules for Materials)

2.10 Corrosion margin

2.10.1 The scantlings determined from the formulae provided in the Rules assume that the materials used are selected, manufactured and protected in such a way that there is negligible loss in strength ~~by~~ due to corrosion.

2.10.3 For naval auxiliaries with scantlings in accordance with the *Rules and Regulations for the Classification of Ships (NSA)* or vessels with scantlings in accordance with the *Rules and Regulations for the Classification of Special Service Craft (NS4)*, the corrosion margins, where specified in those Rules, are to be applied.

~~2.10.3~~ 2.10.4 It is the responsibility of the Owner to specify corrosion margins which meet their operational requirements. Where the Owner does not specify corrosion margins, it is recommended that ~~the following~~ corrosion margins be applied to net scantlings calculated by these Rules, ~~regardless of the type of corrosion protection fitted~~ in areas of the ship's structure where corrosion or wear may be expected to occur in service. The following recommendations are offered as guidance:

- +0,5 mm all hull envelope plating below a line, 1,0 m, above the design waterline
- + 0,5 mm of all plating forming the boundary of tanks
- + 0,5 mm plating forming the lower boundary of wet spaces as appropriate
- +2,0 mm to the keel plate
- + 1,5 mm to flight deck plating.

Consideration should also be given to the addition of a corrosion margin ~~to~~ in the following areas:

- ~~Plating and stiffening at the lower edge of bulkheads bounding wet spaces.~~
- The lower portion of stiffeners located within wet spaces.
- Stiffeners located within tanks.
- All tanks containing corrosive fluids and areas where spillage of corrosive fluids could occur.
- The base of mast structures.
- All uncoated structures.

2.10.5 Where a corrosion margin is specified, submitted plans are to be in accordance with Ch 1, 2.2.1.

~~2.10.4~~ 2.10.6 Ships with an Owner specified corrosion margin will be eligible for an enhanced scantling notation, see Pt 3, Ch 6,6.

Section 6

Inspection and testing procedures

6.4 Structural testing

(Part only shown)

Table 6.6.1 Testing requirements

Item to be tested	Testing procedure	Installation testing requirement
Double bottom tanks	Structural (1)	The greater of: — head of water up to the top of the overflow — head of water representing the maximum pressure experienced in service for which elastic design criteria were used
NOTES 1. Leak or hydropneumatic testing may be accepted, provided that at least one tank of each type is structurally tested, to be selected in connection with the approval of the design, see 6.7. 2. When hose testing cannot be performed without damaging possible outfittings already installed, it may be replaced by a careful visual inspection of all the crossings and welded joints. Where necessary, dye penetrant test or ultrasonic leak test may be required. 3. Where applicable testing of the after peak is to be carried out after the stern tube has been fitted. 4. The highest point of the tank is generally to exclude hatchways. 5. If leak or hydropneumatic testing is carried out, arrangements are to be made to ensure that no pressure in excess of 0,30 bar (0,30 kgf/cm²) can be applied. 6. Watertight doors and hatches to be supplied with a test certificate stating the maximum pressure head for which they are suitable. For large watertight closing appliances that cannot be tested, see Pt 4, Ch 3,3.4 or 4.3. 7. See also SOLAS Reg. II-1/16. Where the door has had the full hydrostatic test before installation, the hose test may be replaced by careful visual examination after full operational tests. 8. If the magazine is required to contain an overpressure, for example due to a fire, the testing requirements are to be specified by the Naval Authority magazine safety standard.		

6.8 Gastight testing

6.8.1 Where LR has been requested to witness gastight testing is requested by the Naval Authority in accordance with a specified standard, the boundaries of citadels and zones defined in Pt 4, Ch 1,7 are to be tested for gas tightness using a pressure drop test. In addition, compartments containing noxious or explosive gases such as Acetone, Dope, Flammable stores, Oxygen, etc., are to be subject to a pressure drop test.

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Naval Ships.

Volume 1, Part 1, Chapter 2

1.1.10	Reference to sub-Section 3.9 <i>now reads</i> 3.10
1.6.1	Reference to paragraph 3.9.9 <i>now reads</i> 3.10.9
1.6.1	Reference to paragraph 3.9.12 <i>now reads</i> 3.10.12
3.1.2	Reference to sub-Section 3.2 <i>now reads</i> 3.3
3.2.5 now 3.3.5	Reference to sub-Section 3.11 <i>now reads</i> 3.2
3.3.1(a) now 3.4.1(a)	Reference to sub-Section 3.4 <i>now reads</i> 3.5
3.3.1(b) now 3.4.1(b)	Reference to sub-Section 3.5 <i>now reads</i> 3.6
3.3.1(c) now 3.4.1(c)	Reference to sub-Section 3.6 <i>now reads</i> 3.7
3.3.1(d) now 3.4.1(d)	Reference to sub-Section 3.7 <i>now reads</i> 3.8
3.3.1(e) now 3.4.1(e)	Reference to sub-Section 3.8 <i>now reads</i> 3.9
3.3.1(f) now 3.4.1(f)	Reference to sub-Section 3.9 <i>now reads</i> 3.10
Table 2.3.1	Reference to sub-Section 3.4 <i>now reads</i> 3.5
Table 2.3.1	Reference to sub-Section 3.5 <i>now reads</i> 3.6
Table 2.3.1	Reference to sub-Section 3.6 <i>now reads</i> 3.7
Table 2.3.1	Reference to sub-Section 3.7 <i>now reads</i> 3.8
Table 2.3.1	Reference to sub-Section 3.9 <i>now reads</i> 3.10
Table 2.3.2	Reference to sub-Section 3.8 <i>now reads</i> 3.9
3.8.1 now 3.9.1	Reference to paragraph 3.10.2 <i>now reads</i> 6.3.3
3.8.1 now 3.9.1	Reference to paragraph 3.10.3 <i>now reads</i> 6.3.4
3.9.1 now 3.10.1	Reference to paragraph 3.9.2 <i>now reads</i> 3.10.2

3.11.1(c) now 3.2.1(c)	Reference to paragraph 3.2.5 <i>now reads</i> 3.3.5
3.11.3 now 3.2.3	Reference to paragraph 3.2.5 <i>now reads</i> 3.3.5
4.1.1	Reference to Chapter 3, 1.5.3 <i>now reads</i> Chapter 3, 1.5.4

Volume 1, Part 1, Chapter 3

1.8.2	Reference to paragraph 1.6.6 <i>now reads</i> 1.6.11
3.2.2	Reference to paragraph 1.5.8 <i>now reads</i> 1.5.9
3.2.2(a)	Reference to paragraph 1.5.8 <i>now reads</i> 1.5.9
3.2.4	Reference to paragraph 1.5.4 <i>now reads</i> 1.5.5
5.3.1	Reference to paragraph 1.5.4 <i>now reads</i> 1.5.5
Table 3.5.1	Reference to paragraph 1.5.3 <i>now reads</i> 1.5.4
Table 3.5.1	Reference to paragraph 1.5.4 <i>now reads</i> 1.5.5
5.4.2	Reference to paragraph 1.5.9 <i>now reads</i> 1.5.10
Table 3.6.1	Reference to paragraph 1.5.8 <i>now reads</i> 1.5.9

Volume 1, Part 3, Chapter 1

3.1.4	Reference to Part 1, Chapter 2, 3.11 <i>now reads</i> Part 1, Chapter 2, 3.2
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Volume 1, Part 3, Chapter 2

1.5.8	Reference to Pt, 1, Ch 2, 3.6.9 <i>now reads</i> Pt 1, Ch 2, 3.6.1
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Volume 1, Part 3, Chapter 5

1.3.4	Reference to Part 1, Chapter 2, 3.5 <i>now reads</i> Part 1, Chapter 2, 3.6
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Volume 1, Part 3, Chapter 6

5.1.2	Reference to Part 1, Chapter 2, 3.9.5 <i>now reads</i> Part 1, Chapter 2, 3.10.4
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Please note that the reference to the Rules for Ships is incorrect and should be deleted. This reference refers to the Rules for Naval Ships.

Volume 1, Part 4, Chapter 1

2.2.4	Reference to Part 1, Chapter 2, 3.9.7 <i>now reads</i> Part 1, Chapter 2, 3.10.7
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Cross-references

Volume 1, Part 4, Chapter 3

- 3.6.1 Reference to Part 1, Chapter 2,3.5 *now reads* Part 1, Chapter 2,3.6

Volume 1, Part 5, Chapter 2

- 4.4.1 Reference to Part 1, Chapter 2,3.8 *now reads* Part 1, Chapter 2,3.9

Volume 1, Part 6, Chapter 4

- 1.1.4 Reference to Part 1, Chapter 2,3.6.1 *now reads* Part 1, Chapter 2,3.7.1
- 1.1.5 Reference to Part 1, Chapter 2,3.6.1 *now reads* Part 1, Chapter 2,3.7.1

Volume 1, Part 6, Chapter 6

- 2.6.2 Reference to Part 1, Chapter 2,3.9 *now reads* Part 1, Chapter 2,3.10

Volume 2, Part 1, Chapter 1

- 6.11.3 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2

Volume 2, Part 1, Chapter 5

- 1.1.2 Reference to Volume 1, Part 1, Chapter 2,3.8 *now reads* Volume 1, Part 1, Chapter 2,3.9

Volume 2, Part 11, Chapter 3

- 1.1.4 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2

Volume 3, Part 1, Chapter 1

- 1.1.1 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13
- 2.1.1 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13
- 2.2.2 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13
- 2.3.2 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13
- 2.3.4(a) Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13

- 2.4.2 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13

- 2.5.3 Reference to Volume 1, Part 1, Chapter 2,3.9.13 *now reads* Volume 1, Part 1, Chapter 2,3.10.13

Volume 3, Part 1, Chapter 2

- 1.1.4 Reference to Volume 1, Part 1, Chapter 2,3.8.2 *now reads* Volume 1, Part 1, Chapter 2,3.9.2

Volume 3, Part 1, Chapter 6

- 2.2.1 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2
- 2.3.1 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2

Volume 3, Part 3, Chapter 1

- 6.2.3 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2

Volume 3, Part 3, Chapter 2

- 3.1.1(a) Reference to Volume 1, Part 1, Chapter 2,3.7 *now reads* Volume 1, Part 1, Chapter 2,3.8
- 8.1.3 Reference to Volume 1, Part 1, Chapter 2,3.8 *now reads* Volume 1, Part 1, Chapter 2,3.9

Volume 3, Part 3, Chapter 3

- 3.1.1(a) Reference to Volume 1, Part 1, Chapter 2,3.7 *now reads* Volume 1, Part 1, Chapter 2,3.8

Volume 3, Part 3, Chapter 4

- 3.1.1(a) Reference to Volume 1, Part 1, Chapter 2,3.7 *now reads* Volume 1, Part 1, Chapter 2,3.8

Volume 3, Part 3, Chapter 5

- 3.2.1(a) Reference to Volume 1, Part 1, Chapter 2,3.7 *now reads* Volume 1, Part 1, Chapter 2,3.8

Volume 3, Part 3, Chapter 6

- 1.3.1 Reference to Volume 1, Part 1, Chapter 2,3.11 *now reads* Volume 1, Part 1, Chapter 2,3.2

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